

## MODEL TRAIN CONTROL SYSTEM

## BACKGROUND OF THE INVENTION

5 The present invention relates to a system for controlling a model railroad.

Model railroads have traditionally been constructed with of a set of interconnected sections of train track, electric switches between different sections of the train track, and other electrically operated  
10 devices, such as train engines and draw bridges. Train engines receive their power to travel on the train track by electricity provided by a controller through the track itself. The speed and direction of the train engine is controlled by the level and polarity, respectively, of  
15 the electrical power supplied to the train track. The operator manually pushes buttons or pulls levers to cause the switches or other electrically operated devices to function, as desired. Such model railroad sets are suitable for a single operator, but unfortunately they  
20 lack the capability of adequately controlling multiple trains independently. In addition, such model railroad sets are not suitable for being controlled by multiple operators, especially if the operators are located at different locations distant from the model railroad, such  
25 as different cities.

A digital command control (DCC) system has been developed to provide additional controllability of individual train engines and other electrical devices. Each device the operator desires to control, such as a  
30 train engine, includes an individually addressable digital decoder. A digital command station (DCS) is electrically connected to the train track to provide a command in the form of a set of encoded digital bits to a particular device that includes a digital decoder. The  
35 digital command station is typically controlled by a personal computer. A suitable standard for the digital command control system is the NMRA DCC Standards, issued

March 1997, and is incorporated herein by reference.

While providing the ability to individually control different devices of the railroad set, the DCC system still fails to provide the capability for multiple operators to control the railroad devices, especially if the operators are remotely located from the railroad set and each other.

DigiToys Systems of Lawrenceville, Georgia has developed a software program for controlling a model railroad set from a remote location. The software includes an interface which allows the operator to select desired changes to devices of the railroad set that include a digital decoder, such as increasing the speed of a train or switching a switch. The software issues a command locally or through a network, such as the internet, to a digital command station at the railroad set which executes the command. The protocol used by the software is based on Cobra from Open Management Group where the software issues a command to a communication interface and awaits confirmation that the command was executed by the digital command station. When the software receives confirmation that the command executed, the software program sends the next command through the communication interface to the digital command station. In other words, the technique used by the software to control the model railroad is analogous to an inexpensive printer where commands are sequentially issued to the printer after the previous command has been executed. Unfortunately, it has been observed that the response of the model railroad to the operator appears slow, especially over a distributed network such as the internet. One technique to decrease the response time is to use high-speed network connections but unfortunately such connections are expensive.

What is desired, therefore, is a system for controlling a model railroad that effectively provides a

high-speed connection without the additional expense associated therewith.

The foregoing and other objectives, features, and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

#### SUMMARY OF THE PRESENT INVENTION

The present invention overcomes the aforementioned drawbacks of the prior art, in a first aspect, by providing a system for operating a digitally controlled model railroad that includes transmitting a first command from a first client program to a resident external controlling interface through a first communications transport. A second command is transmitted from a second client program to the resident external controlling interface through a second communications transport. The first command and the second command are received by the resident external controlling interface which queues the first and second commands. The resident external controlling interface sends third and fourth commands representative of the first and second commands, respectively, to a digital command station for execution on the digitally controlled model railroad.

Incorporating a communications transport between the multiple client program and the resident external controlling interface permits multiple operators of the model railroad at locations distant from the physical model railroad and each other. In the environment of a model railroad club where the members want to simultaneously control devices of the same model railroad layout, which preferably includes multiple trains operating thereon, the operators each provide commands to the resistant external controlling interface, and hence the model railroad. In addition by queuing by

commands at a single resident external controlling interface permits controlled execution of the commands by the digitally controlled model railroad, would may otherwise conflict with one another.

5           In another aspect of the present invention the first command is selectively processed and sent to one of a plurality of digital command stations for execution on the digitally controlled model railroad based upon information contained therein. Preferably, the second  
10       command is also selectively processed and sent to one of the plurality of digital command stations for execution on the digitally controlled model railroad based upon information contained therein. The resident external controlling interface also preferably includes a command  
15       queue to maintain the order of the commands.

          The command queue also allows the sharing of multiple devices, multiple clients to communicate with the same device (locally or remote) in a controlled manner, and multiple clients to communicate with  
20       different devices. In other words, the command queue permits the proper execution in the cases of: (1) one client to many devices, (2) many clients to one device, and (3) many clients to many devices.

          In yet another aspect of the present invention  
25       the first command is transmitted from a first client program to a first processor through a first communications transport. The first command is received at the first processor. The first processor provides an acknowledgement to the first client program through the  
30       first communications transport indicating that the first command has properly executed prior to execution of commands related to the first command by the digitally controlled model railroad. The communications transport is preferably a COM or DCOM interface.

35       The model railroad application involves the use of extremely slow real-time interfaces between the digital command stations and the devices of the model



railroad.. In order to increase the apparent speed of execution to the client, other than using high-speed communication interfaces, the resident external controller interface receives the command and provides an  
5 acknowledgement to the client program in a timely manner before the execution of the command by the digital command stations. Accordingly, the execution of commands provided by the resident external controlling interface to the digital command stations occur in a synchronous  
10 manner, such as a first-in-first-out manner. The COM and DCOM communications transport between the client program and the resident external controlling interface is operated in an asynchronous manner, namely providing an acknowledgement thereby releasing the communications  
15 transport to accept further communications prior to the actual execution of the command. The combination of the synchronous and the asynchronous data communication for the commands provides the benefit that the operator considers the commands to occur nearly instantaneously  
20 while permitting the resident external controlling interface to verify that the command is proper and cause the commands to execute in a controlled manner by the digital command stations, all without additional high-speed communication networks. Moreover, for traditional  
25 distributed software execution there is no motivation to provide an acknowledgment prior to the execution of the command because the command executes quickly and most commands are sequential in nature. In other words, the execution of the next command is dependent upon proper  
30 execution of the prior command so there would be no motivation to provide an acknowledgment prior to its actual execution.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

35 FIG. 1 is a block diagram of an exemplary embodiment of a model train control system.

FIG. 2 is a more detailed block diagram of the model train control system of FIG. 1 including external device control logic.

5 FIG. 3 is a block diagram of the external device control logic of FIG. 2.

FIG. 4 is an illustration of a track and signaling arrangement.

FIG. 5 is an illustration of a manual block signaling arrangement.

10 FIG. 6 is an illustration of a track circuit.

FIGS. 7A and 7B are illustrations of block signaling and track capacity.

FIG. 8 is an illustration of different types of signals.

15 FIGS. 9A and 9B are illustrations of speed signaling in approach to a junction.

FIG. 10 is a further embodiment of the system including a dispatcher.

20 FIG. 11 is an exemplary embodiment of a command queue.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a model train control system 10 includes a communications transport 12  
25 interconnecting a client program 14 and a resident external controlling interface 16. The client program 14 executes on the model railroad operator's computer and may include any suitable system to permit the operator to provide desired commands to the resident external  
30 controlling interface 16. For example, the client program 14 may include a graphical interface representative of the model railroad layout where the operator issues commands to the model railroad by making changes to the graphical interface. The client program  
35 14 also defines a set of Application Programming Interfaces (API's), described in detail later, which the operator accesses using the graphical interface or other

programs such as Visual Basic, C++, Java, or browser based applications. There may be multiple client programs interconnected with the resident external controlling interface 16 so that multiple remote  
5 operators may simultaneously provide control commands to the model railroad.

The communications transport 12 provides an interface between the client program 14 and the resident external controlling interface 16. The communications  
10 transport 12 may be any suitable communications medium for the transmission of data, such as the internet, local area network, satellite links, or multiple processes operating on a single computer. The preferred interface to the communications transport 12 is a COM or DCOM  
15 interface, as developed for the Windows operating system available from Microsoft Corporation. The communications transport 12 also determines if the resident external controlling interface 16 is system resident or remotely located on an external system. The communications  
20 transport 12 may also use private or public communications protocol as a medium for communications. The client program 14 provides commands and the resident external controlling interface 16 responds to the communications transport 12 to exchange information.  
25 A description of COM (common object model) and DCOM (distributed common object model) is provided by Chappel in a book entitled Understanding ActiveX and OLE, Microsoft Press, and is incorporated by reference herein.

Incorporating a communications transport 12  
30 between the client program(s) 14 and the resident external controlling interface 16 permits multiple operators of the model railroad at locations distant from the physical model railroad and each other. In the environment of a model railroad club where the members  
35 want to simultaneously control devices of the same model railroad layout, which preferably includes multiple trains operating thereon, the operators each provide

commands to the resistant external controlling interface, and hence the model railroad.

The manner in which commands are executed for the model railroad under COM and DCOM may be as follows.

5 The client program 14 makes requests in a synchronous manner using COM/DCOM to the resident external controller 16. The synchronous manner of the request is the technique used by COM and DCOM to execute commands. The communications transport 12 packages the command for  
10 the transport mechanism to the resident external controlling interface 16. The resident external controlling interface 16 then passes the command to the digital command stations 18 which in turn executes the command. After the digital command station 18 executes  
15 the command an acknowledgement is passed back to the resident external controlling interface 16 which in turn passes an acknowledgement to the client program 14. Upon receipt of the acknowledgement by the client program 14, the communications transport 12 is again available to  
20 accept another command. The train control system 10, without more, permits execution of commands by the digital command stations 18 from multiple operators, but like the DigiToys Systems' software the execution of commands is slow.

25 The present inventor came to the realization that unlike traditional distributed systems where the commands passed through a communications transport are executed nearly instantaneously by the server and then an acknowledgement is returned to the client, the model  
30 railroad application involves the use of extremely slow real-time interfaces between the digital command stations and the devices of the model railroad. The present inventor came to the further realization that in order to increase the apparent speed of execution to the client,  
35 other than using high-speed communication interfaces, the resident external controller interface 16 should receive the command and provide an acknowledgement to the client

program 12 in a timely manner before the execution of the command by the digital command stations 18. Accordingly, the execution of commands provided by the resident external controlling interface 16 to the digital command stations 18 occur in a synchronous manner, such as a first-in-first-out manner. The COM and DCOM communications transport 12 between the client program 14 and the resident external controlling interface 16 is operated in an asynchronous manner, namely providing an acknowledgement thereby releasing the communications transport 12 to accept further communications prior to the actual execution of the command. The combination of the synchronous and the asynchronous data communication for the commands provides the benefit that the operator considers the commands to occur nearly instantaneously while permitting the resident external controlling interface 16 to verify that the command is proper and cause the commands to execute in a controlled manner by the digital command stations 18, all without additional high-speed communication networks. Moreover, for traditional distributed software execution there is no motivation to provide an acknowledgment prior to the execution of the command because the command executes quickly and most commands are sequential in nature. In other words, the execution of the next command is dependent upon proper execution of the prior command so there would be no motivation to provide an acknowledgment prior to its actual execution. It is to be understood that other devices, such as digital devices, may be controlled in a manner as described for model railroads.

Referring to FIG. 2, the client program 14 sends a command over the communications transport 12 that is received by an asynchronous command processor 100. The asynchronous command processor 100 queries a local database storage 102 to determine if it is necessary to package a command to be transmitted to a command queue 104. The local database storage 102 primarily contains

the state of the devices of the model railroad, such as for example, the speed of a train, the direction of a train, whether a draw bridge is up or down, whether a light is turned on or off, and the configuration of the model railroad layout. If the command received by the asynchronous command processor 100 is a query of the state of a device, then the asynchronous command processor 100 retrieves such information from the local database storage 102 and provides the information to an asynchronous response processor 106. The asynchronous response processor 106 then provides a response to the client program 14 indicating the state of the device and releases the communications transport 12 for the next command.

The asynchronous command processor 100 also verifies, using the configuration information in the local database storage 102, that the command received is a potentially valid operation. If the command is invalid, the asynchronous command processor 100 provides such information to the asynchronous response processor 106, which in turn returns an error indication to the client program 14.

The asynchronous command processor 100 may determine that the necessary information is not contained in the local database storage 102 to provide a response to the client program 14 of the device state or that the command is a valid action. Actions may include, for example, an increase in the train's speed, or turning on/off of a device. In either case, the valid unknown state or action command is packaged and forwarded to the command queue 104. The packaging of the command may also include additional information from the local database storage 102 to complete the client program 14 request, if necessary. Together with packaging the command for the command queue 104, the asynchronous command processor 100 provides a command to the asynchronous request processor 106 to provide a response to the client program 14

indicating that the event has occurred, even though such an event has yet to occur on the physical railroad layout.

As such, it can be observed that whether or not the command is valid, whether or not the information requested by the command is available to the asynchronous command processor 100, and whether or not the command has executed, the combination of the asynchronous command processor 100 and the asynchronous response processor 106 both verifies the validity of the command and provides a response to the client program 14 thereby freeing up the communications transport 12 for additional commands. Without the asynchronous nature of the resident external controlling interface 16, the response to the client program 14 would be, in many circumstances, delayed thereby resulting in frustration to the operator that the model railroad is performing in a slow and painstaking manner. In this manner, the railroad operation using the asynchronous interface appears to the operator as nearly instantaneously responsive.

Each command in the command queue 104 is fetched by a synchronous command processor 110 and processed. The synchronous command processor 110 queries a controller database storage 112 for additional information, as necessary, and determines if the command has already been executed based on the state of the devices in the controller database storage 112. In the event that the command has already been executed, as indicated by the controller database storage 112, then the synchronous command processor 110 passes information to the command queue 104 that the command has been executed or the state of the device. The asynchronous response processor 106 fetches the information from the command cue 104 and provides a suitable response to the client program 14, if necessary, and updates the local database storage 102 to reflect the updated status of the railroad layout devices.

If the command fetched by the synchronous command processor 110 from the command queue 104 requires execution by external devices, such as the train engine, then the command is posted to one of several external device control logic 114 blocks. The external device control logic 114 processes the command from the synchronous command processor 110 and issues appropriate control commands to the interface of the particular external device 116 to execute the command on the device and ensure that an appropriate response was received in response. The external device is preferably a digital command control device that transmits digital commands to decoders using the train track. There are several different manufacturers of digital command stations, each of which has a different set of input commands, so each external device is designed for a particular digital command station. In this manner, the system is compatible with different digital command stations. The digital command stations 18 of the external devices 116 provide a response to the external device control logic 114 which is checked for validity and identified as to which prior command it corresponds to so that the controller database storage 112 may be updated properly. The process of transmitting commands to and receiving responses from the external devices 116 is slow.

The synchronous command processor 110 is notified of the results from the external control logic 114 and, if appropriate, forwards the results to the command queue 104. The asynchronous response processor 100 clears the results from the command queue 104 and updates the local database storage 102 and sends an asynchronous response to the client program 14, if needed. The response updates the client program 14 of the actual state of the railroad track devices, if changed, and provides an error message to the client program 14 if the devices actual state was previously



improperly reported or a command did not execute properly.

The use of two separate database storages, each of which is substantially a mirror image of the other, provides a performance enhancement by a fast  
5 acknowledgement to the client program 14 using the local database storage 102 and thereby freeing up the communications transport 12 for additional commands. In addition, the number of commands forwarded to the  
10 external device control logic 114 and the external devices 116, which are relatively slow to respond, is minimized by maintaining information concerning the state and configuration of the model railroad. Also, the use of two separate database tables 102 and 112 allows more  
15 efficient multi-threading on multi-processor computers.

In order to achieve the separation of the asynchronous and synchronous portions of the system the command queue 104 is implemented as a named pipe, as developed by Microsoft for Windows. The queue 104 allows  
20 both portions to be separate from each other, where each considers the other to be the destination device. In addition, the command queue maintains the order of operation which is important to proper operation of the system.

The use of a single command queue 104 allows  
25 multiple instantiations of the asynchronous functionality, with one for each different client. The single command queue 104 also allows the sharing of multiple devices, multiple clients to communicate with  
30 the same device (locally or remote) in a controlled manner, and multiple clients to communicate with different devices. In other words, the command queue 104 permits the proper execution in the cases of: (1) one client to many devices, (2) many clients to one device,  
35 and (3) many clients to many devices.

The present inventor came to the realization that the digital command stations provided by the

different vendors have at least three different techniques for communicating with the digital decoders of the model railroad set. The first technique, generally referred to as a transaction (one or more operations), is a synchronous communication where a command is transmitted, executed, and a response is received therefrom prior to the transmission of the next sequentially received command. The DCS may execute multiple commands in this transaction. The second technique is a cache with out of order execution where a command is executed and a response received therefrom prior to the execution of the next command, but the order of execution is not necessarily the same as the order that the commands were provided to the command station. The third technique is a local-area-network model where the commands are transmitted and received simultaneously. In the LAN model there is no requirement to wait until a response is received for a particular command prior to sending the next command. Accordingly, the LAN model may result in many commands being transmitted by the command station that have yet to be executed. In addition, some digital command stations use two or more of these techniques.

With all these different techniques used to communicate with the model railroad set and the system providing an interface for each different type of command station, there exists a need for the capability of matching up the responses from each of the different types of command stations with the particular command issued for record keeping purposes. Without matching up the responses from the command stations, the databases can not be updated properly.

Validation functionality is included within the external device control logic 114 to accommodate all of the different types of command stations. Referring to FIG. 3, an external command processor 200 receives the validated command from the synchronous command processor

110. The external command processor 200 determines which device the command should be directed to, the particular, type of command it is, and builds state information for the command. The state information includes, for  
5 example, the address, type, port, variables, and type of commands to be sent out. In other words, the state information includes a command set for a particular device on a particular port device. In addition, a copy of the original command is maintained for verification  
10 purposes. The constructed command is forwarded to the command sender 202 which is another queue, and preferably a circular queue. The command sender 202 receives the command and transmits commands within its queue in a repetitive nature until the command is removed from its  
15 queue. A command response processor 204 receives all the commands from the command stations and passes the commands to the validation function 206. The validation function 206 compares the received command against potential commands that are in the queue of the command  
20 sender 202 that could potentially provide such a result. The validation function 206 determines one of four potential results from the comparison. First, the results could be simply bad data that is discarded. Second, the results could be partially executed commands  
25 which are likewise normally discarded. Third, the results could be valid responses but not relevant to any command sent. Such a case could result from the operator manually changing the state of devices on the model railroad or from another external device, assuming a  
30 shared interface to the DCS. Accordingly, the results are validated and passed to the result processor 210. Fourth, the results could be valid responses relevant to a command sent. The corresponding command is removed from the command sender 202 and the results passed to the  
35 result processor 210. The commands in the queue of the command sender 202, as a result of the validation process 206, are retransmitted a predetermined number of times,

then if error still occurs the digital command station is reset, which if the error still persists then the command is removed and the operator is notified of the error.

5

## APPLICATION PROGRAMMING INTERFACE

Train Tools<sup>TM</sup> Interface Description  
Building your own visual interface to a model railroad  
Copyright 1992-1998 KAM Industries.  
Computer Dispatcher, Engine Commander, The Conductor,  
10 Train Server, and Train Tools are Trademarks of KAM  
Industries, all Rights Reserved.  
Questions concerning the product can be EMAILED to:  
traintools@kam.rain.com  
You can also mail questions to:  
15 KAM Industries  
2373 NW 185th Avenue Suite 416  
Hillsboro, Oregon 97124  
FAX - (503) 291-1221

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40		KamDecoderGetModelFacility
		KamDecoderGetObjCount
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50		KamEngPutSpeed
		KamEngGetSpeedSteps
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		KamEngGetFunction
		KamEngPutFunction
55		KamEngGetFunctionMax
		KamEngGetName

```

KamEngPutName
KamEngGetFunctionName
KamEngPutFunctionName
KamEngGetConsistMax
5   KamEngPutConsistParent
    KamEngPutConsistChild
    KamEngPutConsistRemoveObj
3.7 Commands to control accessory decoders
10   KamAccGetFunction
    KamAccGetFunctionAll
    KamAccPutFunction
    KamAccPutFunctionAll
    KamAccGetFunctionMax
    KamAccGetName
15   KamAccPutName
    KamAccGetFunctionName
    KamAccPutFunctionName
    KamAccRegFeedback
    KamAccRegFeedbackAll
20   KamAccDelFeedback
    KamAccDelFeedbackAll
3.8 Commands to control the command station
    KamOprPutTurnOnStation
    KamOprPutStartStation
25   KamOprPutClearStation
    KamOprPutStopStation
    KamOprPutPowerOn
    KamOprPutPowerOff
    KamOprPutHardReset
30   KamOprPutEmergencyStop
    KamOprGetStationStatus
3.9 Commands to configure the command station
    communication port
    KamPortPutConfig
35   KamPortGetConfig
    KamPortGetName
    KamPortPutMapController
    KamPortGetMaxLogPorts
    KamPortGetMaxPhysical
40   3.10 Commands that control command flow to the command
        station
        KamCmdConnect
        KamCmdDisConnect
        KamCmdCommand
45   3.11 Cab Control Commands
        KamCabGetMessage
        KamCabPutMessage
        KamCabGetCabAddr
        KamCabPutAddrToCab
50   3.12 Miscellaneous Commands
        KamMiscGetErrorMsg
        KamMiscGetClockTime
        KamMiscPutClockTime
        KamMiscGetInterfaceVersion
55   KamMiscSaveData
        KamMiscGetControllerName

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```

KamMiscGetControllerNameAtPort
KamMiscGetCommandStationValue
KamMiscSetCommandStationValue
KamMiscGetCommandStationIndex
5  KamMiscMaxControllerID
KamMiscGetControllerFacility

```

## I. OVERVIEW

10 This document is divided into two sections, the Tutorial, and the IDL Command Reference. The tutorial shows the complete code for a simple Visual BASIC program that controls all the major functions of a locomotive. 15 This program makes use of many of the commands described in the reference section. The IDL Command Reference describes each command in detail.

## I. TUTORIAL

20 A. Visual BASIC Throttle Example Application

The following application is created using the Visual BASIC source code in the next section. It 25 controls all major locomotive functions such as speed, direction, and auxiliary functions.

### A. Visual BASIC Throttle Example Source Code

```

30 ' Copyright 1998, KAM Industries. All rights reserved.
'
' This is a demonstration program showing the
' integration of VisualBasic and Train Server(tm)
35 ' interface. You may use this application for non
' commercial usage.
'
'$Date: $
'$Author: $
40 '$Revision: $
'$Log: $
'
' Engine Commander, Computer Dispatcher, Train Server,
' Train Tools, The Conductor and kamind are registered
45 ' Trademarks of KAM Industries. All rights reserved.
'
' This first command adds the reference to the Train
' ServerT Interface object Dim EngCmd As New EngComIfc
'
50 ' Engine Commander uses the term Ports, Devices and
' Controllers
' Ports -> These are logical ids where Decoders are
' assigned to. Train ServerT Interface supports a
' limited number of logical ports. You can also think
55 ' of ports as mapping to a command station type. This
' allows you to move decoders between command station

```

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without losing any information about the decoder
Devices -> These are communications channels
configured in your computer.
5 You may have a single device (com1) or multiple
devices
(COM 1 - COM8, LPT1, Other). You are required to
map a port to a device to access a command station.
10 Devices start from ID 0 -> max id (FYI; devices do
not necessarily have to be serial channel. Always
check the name of the device before you use it as
well as the maximum number of devices supported.
The Command
EngCmd.KamPortGetMaxPhysical(lMaxPhysical, lSerial,
15 lParallel) provides means that... lMaxPhysical =
lSerial + lParallel + lOther

Controller - These are command the command station
like LENZ, Digitrax
20 Northcoast, EasyDCC, Marklin... It is recommend
that you check the command station ID before you
use it.

Errors - All commands return an error status. If
25 the error value is non zero, then the
other return arguments are invalid. In
general, non zero errors means command was
not executed. To get the error message,
you need to call KamMiscErrorMessage and
30 supply the error number

To Operate your layout you will need to perform a
mapping between a Port (logical reference), Device
35 (physical communications channel) and a Controller
(command station) for the program to work. All
references uses the logical device as the reference
device for access.

Addresses used are an object reference. To use an
40 address you must add the address to the command
station using KamDecoderPutAdd ... One of the return
values from this operation is an object reference
that is used for control.

45 We need certain variables as global objects; since
the information is being used multiple times

Dim iLogicalPort, iController, iComPort
Dim iPortRate, iPortParity, iPortStop, iPortRetrans,
50 iPortWatchdog, iPortFlow, iPortData
Dim lEngineObject As Long, iDecoderClass As Integer,
iDecoderType As Integer
Dim lMaxController As Long
Dim lMaxLogical As Long, lMaxPhysical As Long, lMaxSerial
55 As Long, lMaxParallel As Long
*****

```



5  
10  
15  
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35  
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45  
50

```

iLogicalPort = 1 'Select Logical port 1 for
                    communications
iController = 1 'Select controller from the list
                    above.
5   iComPort = 0 ' use COM1; 0 means com1 (Digitrax must
                    use Com1 or Com2)
        'Digitrax Baud rate requires 16.4K!
        'Most COM ports above Com2 do not
        'support 16.4K. Check with the
10   'manufacture of your smart com card
        'for the baud rate. Keep in mind that
        'Dumb com cards with serial port
        'support Com1 - Com4 can only support
        '2 com ports (like com1/com2
15   'or com3/com4)
        'If you change the controller, do not
        'forget to change the baud rate to
        'match the command station. See your
        'user manual for details
20   '*****
        ' 0: // Baud rate is 300
        ' 1: // Baud rate is 1200
        ' 2: // Baud rate is 2400
        ' 3: // Baud rate is 4800
25   ' 4: // Baud rate is 9600
        ' 5: // Baud rate is 14.4
        ' 6: // Baud rate is 16.4
        ' 7: // Baud rate is 19.2
        iPortRate = 4
30   ' Parity values 0-4 -> no, odd, even, mark,
        space
        iPortParity = 0
        ' Stop bits 0,1,2 -> 1, 1.5, 2
        iPortStop = 0
35   iPortRetrans = 10
        iPortWatchdog = 2048
        iPortFlow = 0
        ' Data bits 0 - > 7 Bits, 1-> 8 bits
        iPortData = 1.
40
        'Display the port and controller information
        iError = EngCmd.KamPortGetMaxLogPorts(lMaxLogical)
        iError = EngCmd.KamPortGetMaxPhysical(lMaxPhysical,
        lMaxSerial, lMaxParallel)
45
        ' Get the port name and do some checking...
        iError = EngCmd.KamPortGetName(iComPort, strCom)
        SetError (iError)
        If (iComPort > lMaxSerial) Then MsgBox ("Com port
50   our of range")
        iError =
            EngCmd.KamMiscGetControllerName(iController,
            strCntrl)

```

```

        If (iLogicalPort > lMaxLogical) Then MsgBox
("Logical port out of range")
        SetError (iError)
    End If
5
    'Display values in Throttle..
    LogPort.Caption = iLogicalPort
    ComPort.Caption = strCom
    Controller.Caption = strCntrl
10
End Sub

'*****
15 'Send Command
'Note:
'    Please follow the command order.  Order is important
'    for the application to work!
'*****
20 Private Sub Command_Click()
    'Send the command from the interface to the command
    station, use the engineObject
    Dim iError, iSpeed As Integer
    If Not Connect.Enabled Then
25        'TrainTools interface is a caching interface.
        'This means that you need to set up the CV's or
        'other operations first; then execute the
        'command.
        iSpeed = Speed.Text
30        iError =
        EngCmd.KamEngPutFunction(lEngineObject, 0, F0.Value)
        iError =
        EngCmd.KamEngPutFunction(lEngineObject, 1,
        F1.Value)
35        iError =
        EngCmd.KamEngPutFunction(lEngineObject, 2,
        F2.Value)
        iError =
        EngCmd.KamEngPutFunction(lEngineObject, 3,
40        F3.Value)
        iError = EngCmd.KamEngPutSpeed(lEngineObject,
        iSpeed, Direction.Value)
        If iError = 0 Then iError =
        EngCmd.KamCmdCommand(lEngineObject)
45        SetError (iError)
    End If

End Sub

50 '*****
'Connect Controller
'*****
Private Sub Connect_Click()
    Dim iError As Integer
55    'These are the index values for setting up the port
    for use

```

```

' PORT_RETRANS      0  // Retrans index
' PORT_RATE         1  // Retrans index
' PORT_PARITY        2  // Retrans index
' PORT_STOP          3  // Retrans index
5 ' PORT_WATCHDOG     4  // Retrans index
' PORT_FLOW          5  // Retrans index
' PORT_DATABITS      6  // Retrans index
' PORT_DEBUG         7  // Retrans index
' PORT_PARALLEL      8  // Retrans index
10 ' These are the index values for setting up the
    port for use
' PORT_RETRANS      0  // Retrans index
' PORT_RATE         1  // Retrans index
' PORT_PARITY        2  // Retrans index
15 ' PORT_STOP          3  // Retrans index
' PORT_WATCHDOG     4  // Retrans index
' PORT_FLOW          5  // Retrans index
' PORT_DATABITS      6  // Retrans index
' PORT_DEBUG         7  // Retrans index
20 ' PORT_PARALLEL      8  // Retrans index
iError = EngCmd.KamPortPutConfig(iLogicalPort, 0,
iPortRetrans, 0) ' setting PORT_RETRANS
iError = EngCmd.KamPortPutConfig(iLogicalPort, 1,
iPortRate, 0) ' setting PORT_RATE
25 iError = EngCmd.KamPortPutConfig(iLogicalPort, 2,
iPortParity, 0) ' setting PORT_PARITY
iError = EngCmd.KamPortPutConfig(iLogicalPort, 3,
iPortStop, 0) ' setting PORT_STOP
iError = EngCmd.KamPortPutConfig(iLogicalPort, 4,
30 iPortWatchdog, 0) ' setting PORT_WATCHDOG
iError = EngCmd.KamPortPutConfig(iLogicalPort, 5,
iPortFlow, 0) ' setting PORT_FLOW
iError = EngCmd.KamPortPutConfig(iLogicalPort, 6,
iPortData, 0) ' setting PORT_DATABITS
35
' We need to set the appropriate debug mode for display..
' this command can only be sent if the following is true
' -Controller is not connected
' -port has not been mapped
40 ' -Not share ware version of application (Shareware
    always set to 130)
' Write Display Log Debug
' File Win Level Value
' 1 + 2 + 4 = 7 -> LEVEL1 -- put packets into
45 ' queues
' 1 + 2 + 8 = 11 -> LEVEL2 -- Status messages
' send to window
' 1 + 2 + 16 = 19 -> LEVEL3 --
' 1 + 2 + 32 = 35 -> LEVEL4 -- All system
50 ' semaphores/critical sections
' 1 + 2 + 64 = 67 -> LEVEL5 -- detailed
' debugging information
' 1 + 2 + 128 = 131 -> COMMONLY -- Read comm write
' comm ports
55

```

```

'You probably only want to use values of 130. This will
'give you a display what is read or written to the
'controller. If you want to write the information to
'disk, use 131. The other information is not valid for
5 'end users.

' Note: 1.      This does effect the performance of you
'              system; 130 is a save value for debug
'              display. Always set the key to 1, a value
10 '              of 0 will disable debug
'              2.      The Digitrax control codes displayed are
'                      encrypted. The information that you
'                      determine from the control codes is that
'                      information is sent (S) and a response is
15 '                      received (R)
'
iDebugMode = 130
iValue = Value.Text ' Display value for reference
iError = EngCmd.KamPortPutConfig(iLogicalPort, 7, iDebug,
20 iValue) ' setting PORT_DEBUG

'Now map the Logical Port, Physical device, Command
'      station and Controller
iError = EngCmd.KamPortPutMapController(iLogicalPort,
25 iController, iComPort)
iError = EngCmd.KamCmdConnect(iLogicalPort)
iError = EngCmd.KamOprPutTurnOnStation(iLogicalPort)
If (iError) Then
    SetButtonState (False)
30 Else
    SetButtonState (True)
End If
SetError (iError) 'Displays the error message and error
'      number
35 End Sub
'*****
'Set the address button
'*****
40 Private Sub DCCAddr_Click()
    Dim iAddr, iStatus As Integer
    ' All addresses must be match to a logical port to
    ' operate
    iDecoderType = 1 ' Set the decoder type to an NMRA
45 baseline decoder ( 1 - 8 reg)
    iDecoderClass = 1 ' Set the decoder class to Engine
    decoder (there are only two classes of decoders;
    Engine and Accessory)

50 'Once we make a connection, we use the lEngineObject
'as the reference object to send control information
If (Address.Text > 1) Then
    iStatus = EngCmd.KamDecoderPutAdd(Address.Text,
55 iLogicalPort, iLogicalPort, 0,
    iDecoderType, lEngineObject)
SetError (iStatus)

```

```

    If (lEngineObject) Then
        Command.Enabled = True--'turn on the control
        (send) button
        Throttle.Enabled = True ' Turn on the throttle
5      Else
        MsgBox ("Address not set, check error message")
        End If
    Else
        MsgBox ("Address must be greater then 0 and
10      less then 128")
        End If

End Sub

15  '*****
'Disconenct button
'*****
Private Sub Disconnect_Click()
    Dim iError As Integer
20    iError = EngCmd.KamCmdDisconnect(iLogicalPort)
    SetError (iError)
    SetButtonState (False)
End Sub
'*****
25  'Display error message
'*****
Private Sub SetError(iError As Integer)
    Dim szError As String
    Dim iStatus
30    ' This shows how to retrieve a sample error message
    from the interface for the status received.
    iStatus = EngCmd.KamMiscGetErrorMsg(iError, szError)
    ErrorMsg.Caption = szError
    Result.Caption = Str(iStatus)
35  End Sub
'*****
'Set the Form button state
'*****
Private Sub SetButtonState(iState As Boolean)
40    'We set the state of the buttons; either connected
    or disconnected
    If (iState) Then
        Connect.Enabled = False
        Disconnect.Enabled = True
        ONCmd.Enabled = True
45        OffCmd.Enabled = True
        DCCAddr.Enabled = True
        UpDownAddress.Enabled = True
        'Now we check to see if the Engine Address has been
        'set; if it has we enable the send button
50    If (lEngineObject > 0) Then
        Command.Enabled = True
        Throttle.Enabled = True

```

```

Else
    Command.Enabled = False
    Throttle.Enabled = False
End If
5      Else
        Connect.Enabled = True
        Disconnect.Enabled = False
        Command.Enabled = False
        ONCmd.Enabled = False
10      OffCmd.Enabled = False
        DCCAddr.Enabled = False
        UpDownAddress.Enabled = False
        Throttle.Enabled = False
        End If
15      End Sub
        '*****
        'Power Off function
        '*****
        Private Sub OffCmd_Click()
20          Dim iError As Integer
              iError = EngCmd.KamOprPutPowerOff(iLogicalPort)
              SetError (iError)
        End Sub
        '*****
25      'Power On function
        '*****
        Private Sub ONCmd_Click()
            Dim iError As Integer
            iError = EngCmd.KamOprPutPowerOn(iLogicalPort)
30          SetError (iError)
        End Sub

        '*****
        'Throttle slider control
35      '*****
        Private Sub Throttle_Click()
            If (lEngineObject) Then
                If (Throttle.Value > 0) Then
                    Speed.Text = Throttle.Value
40                End If
            End If
        End Sub

```

## 45 I. IDL COMMAND REFERENCE

### A. Introduction

50 This document describes the IDL interface to the KAM Industries Engine Commander Train Server. The Train Server DCOM server may reside locally or on a network node This server handles all the background details of controlling your railroad. You write simple, front end programs in a variety of languages such as
55 BASIC, Java, or C++ to provide the visual interface to

the user while the server handles the details of communicating with the command station, etc.

#### A. Data Types

5 Data is passed to and from the IDL interface using a  
several primitive data types. Arrays of these simple  
types are also used. The exact type passed to and from  
your program depends on the programming language your are  
10 using.

The following primitive data types are used:

IDL Type	BASIC Type	C++ Type	Java Type	Description
15 short	short	short	Short	signed integer
int	int	int		Signed integer
BSTR	BSTR	BSTR		Text string
long	long	long		Unsigned 32 bit value

Name	ID	CV	Range	Valid	CV's	Functions	Address	Range	Speed
20 NMRA Compatible		0		None	None	2	1-99	14	
Baseline	1	1-8	1-8	9		1-127	14		
Extended	2	1-106	1-9, 17, 18, 19, 23, 24, 29, 30,						
25 49, 66-95	9	1-10239	14, 28, 128						
All Mobile	3	1-106	1-106	9		1-10239	14, 28, 128		

Name	ID	CV	Range	Valid	CV's	Functions	Address	Range
Accessory		4	513-593	513-593	8		0-511	
30 All Stationary	5	513-1024	513-1024	8			0-511	

A long /DecoderObject/D value is returned by the  
KamDecoderPutAdd call if the decoder is successfully  
registered with the server. This unique opaque ID should  
35 be used for all subsequent calls to reference this  
decoder.

#### A. Commands to access the server configuration variable database

40 This section describes the commands that access  
the server configuration variables (CV) database. These  
CVs are stored in the decoder and control many of its  
characteristics such as its address. For efficiency, a  
45 copy of each CV value is also stored in the server  
database. Commands such as KamCVGetValue and  
KamCVPutValue communicate only with the server, not the  
actual decoder. You then use the programming commands in  
the next section to transfer CVs to and from the decoder.

50



```

0KamCVGetValue
Parameter List Type Range Direction Description
lDecoderObjectID long 1 In Decoder object ID
iCVRegint 1-1024 2 In CV register
5 pCVValue int * 3 Out Pointer to CV value
1 Opaque object ID handle returned by
KamDecoderPutAdd.
2 Range is 1-1024. Maximum CV for this decoder is
given by KamCVGetMaxRegister.
10 3 CV Value pointed to has a range of 0 to 255.
Return Value Type Range Description
iError short 1 Error flag
1 iError = 0 for success. Nonzero is an error number
(see KamMiscGetErrorMsg). KamCVGetValue takes the
15 decoder object ID and configuration variable (CV) number
as parameters. It sets the memory pointed to by pCVValue
to the value of the server copy of the configuration
variable.

20 0KamCVPutValue
Parameter List Type Range Direction Description
lDecoderObjectID long 1 In Decoder object ID
iCVRegint 1-1024 2 In CV register
iCVValue int 0-255 In CV value
25 1 Opaque object ID handle returned by
KamDecoderPutAdd.
2 Maximum CV is 1024. Maximum CV for this decoder is
given by KamCVGetMaxRegister.
Return Value Type Range Description
30 iError short 1 Error flag
1 iError = 0 for success. Nonzero is an error number
(see KamMiscGetErrorMsg).
KamCVPutValue takes the decoder object ID, configuration
variable (CV) number, and a new CV value as parameters.
35 It sets the server copy of the specified decoder CV to
iCVValue.

0KamCVGetEnable
Parameter List Type Range Direction Description
40 lDecoderObjectID long 1 In Decoder object ID
iCVRegint 1-1024 2 In CV number
pEnable int * 3 Out Pointer to CV bit mask
1 Opaque object ID handle returned by
KamDecoderPutAdd.
45 2 Maximum CV is 1024. Maximum CV for this decoder is
given by KamCVGetMaxRegister.
3 0x0001 - SET CV INUSE 0x0002 - SET CV_READ_DIRTY
0x0004 - SET CV_WRITE_DIRTY 0x0008 -
SET CV_ERROR_READ
50 0x0010 - SET CV_ERROR_WRITE
Return Value Type Range Description
iError short 1 Error flag
1 iError = 0 for success. Nonzero is an error number
(see KamMiscGetErrorMsg). KamCVGetEnable takes the
55 decoder object ID, configuration variable (CV) number,

```

and a pointer to store the enable flag as parameters. It sets the location pointed to by *pEnable*.

```

0KamCVPutEnable
5 Parameter List Type Range Direction Description
lDecoderObjectID long 1 In Decoder object ID
iCVRegint 1-1024 2 In CV number
iEnableint 3 In CV bit mask
1 Opaque object ID handle returned by
10 KamDecoderPutAdd.
2 Maximum CV is 1024. Maximum CV for this decoder is
given by KamCVGetMaxRegister.
3 0x0001 - SET_CV_INUSE 0x0002 - SET_CV_READ_DIRTY
0x0004 - SET_CV_WRITE_DIRTY 0x0008 -
15 SET_CV_ERROR_READ
0x0010 - SET_CV_ERROR_WRITE
Return Value Type Range Description
iError short 1 Error flag
1 iError = 0 for success. Nonzero is an error number
20 (see KamMiscGetErrorMsg).
KamCVPutEnable takes the decoder object ID, configuration
variable (CV) number, and a new enable state as
parameters. It sets the server copy of the CV bit mask
to iEnable.
25
0KamCVGetName
Parameter List Type Range Direction Description
iCV int 1-1024 In CV number
30 pbsCVNameString BSTR * 1 Out Pointer to CV
name string
1 Exact return type depends on language. It is
CString * for C++. Empty string on error.
Return Value Type Range Description
iError short 1 Error flag
35 1 iError = 0 for success. Nonzero is an error number
(see KamMiscGetErrorMsg).
KamCVGetName takes a configuration variable (CV) number
as a parameter. It sets the memory pointed to by
pbsCVNameString to the name of the CV as defined in NMRA
40 Recommended Practice RP 9.2.2.

0KamCVGetMinRegister
Parameter List Type Range Direction Description
45 lDecoderObjectID long 1 In Decoder object ID
pMinRegister int * 2 Out Pointer to min CV
register number
1 Opaque object ID handle returned by
KamDecoderPutAdd.
2 Normally 1-1024. 0 on error or if decoder does not
50 support CVs.
Return Value Type Range Description
iError short 1 Error flag
1 iError = 0 for success. Nonzero is an error number
(see KamMiscGetErrorMsg).

```

KamCVGetMinRegister takes a decoder object ID as a parameter. It sets the memory pointed to by pMinRegister to the minimum possible CV register number for the specified decoder.

5

OKamCVGetMaxRegister

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
pMaxRegister	int *	2	Out	Pointer to max CV	

10

register number

1 Opaque object ID handle returned by

KamDecoderPutAdd.

2 Normally 1-1024. 0 on error or if decoder does not support CVs.

15

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number

(see KamMiscGetErrorMsg).

20

KamCVGetMaxRegister takes a decoder object ID as a parameter. It sets the memory pointed to by pMaxRegister to the maximum possible CV register number for the specified decoder.

25

A. Commands to program configuration variables

30

This section describes the commands read and write decoder configuration variables (CVs). You should initially transfer a copy of the decoder CVs to the server using the KamProgramReadDecoderToDataBase command. You can then read and modify this server copy of the CVs. Finally, you can program one or more CVs into the decoder using the KamProgramCV or KamProgramDecoderFromDataBase command. Not that you must first enter programming mode by issuing the KamProgram command before any programming can be done.

35

OKamProgram

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
iProgLogPort	int	1-65535	2	In	Logical programming port ID

40

iProgMode int 3 In Programming mode

45

1 Opaque object ID handle returned by

KamDecoderPutAdd.

2 Maximum value for this server given by

KamPortGetMaxLogPorts.

50

3 0 - PROGRAM\_MODE\_NONE

1 - PROGRAM\_MODE\_ADDRESS 2 -

PROGRAM\_MODE\_REGISTER

3 - PROGRAM\_MODE\_PAGE

4 - PROGRAM\_MODE\_DIRECT

5 - DCODE\_PRGMODE\_OPS\_SHORT

55

6 - PROGRAM\_MODE\_OPS\_LONG

	Return Value	Type	Range	Description
	iError	short	1	Error flag
	1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		
5	KamProgram take the decoder object ID, logical programming port ID, and programming mode as parameters. It changes the command station mode from normal operation (PROGRAM_MODE_NONE) to the specified programming mode. Once in programming modes, any number of programming			
10	commands may be called. When done, you must call KamProgram with a parameter of PROGRAM_MODE_NONE to return to normal operation.			
OKamProgramGetMode				
15	Parameter List	Type	Range	Direction Description
	lDecoderObjectID	long	1	In Decoder object ID
	iProgLogPort	int	1-65535	2 In Logical programming port ID
20	piProgMode	int * 3		Out Programming mode
	1	Opaque object ID handle returned by KamDecoderPutAdd.		
	2	Maximum value for this server given by KamPortGetMaxLogPorts.		
25	3	0 - PROGRAM_MODE_NONE		2 -
	1	- PROGRAM_MODE_ADDRESS		
	PROGRAM_MODE_REGISTER			
	3	- PROGRAM_MODE_PAGE		
	4	- PROGRAM_MODE_DIRECT		
30	5	- DCODE_PRGMODE_OPS_SHORT		
	6	- PROGRAM_MODE_OPS_LONG		
	Return Value	Type	Range	Description
	iError	short	1	Error flag
	1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		
35	KamProgramGetMode take the decoder object ID, logical programming port ID, and pointer to a place to store the programming mode as parameters. It sets the memory pointed to by piProgMode to the present programming mode.			
40	OKamProgramGetStatus			
	Parameter List	Type	Range	Direction Description
	lDecoderObjectID	long	1	In Decoder object ID
	iCVRegint	0-1024	2	In CV number
45	piCVAllStatus	int * 3	Out	Or'd decoder programming status
	1	Opaque object ID handle returned by KamDecoderPutAdd.		
	2	0 returns OR'd value for all CVs. Other values return status for just that CV.		
50	3	0x0001 - SET_CV_INUSE		
		0x0002 - SET_CV_READ_DIRTY		
		0x0004 - SET_CV_WRITE_DIRTY		
		0x0008 - SET_CV_ERROR_READ		
55		0x0010 - SET_CV_ERROR_WRITE		

Return Value    Type            Range            Description  
 iError short 1            Error flag  
 1        iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

5    KamProgramGetStatus take the decoder object ID and  
 pointer to a place to store the OR'd decoder programming  
 status as parameters. It sets the memory pointed to by  
 piProgMode to the present programming mode.

10    OKamProgramReadCV  
 Parameter List Type    Range            Direction    Description  
 lDecoderObjectID long        1        In        Decoder object ID  
 iCVRegint        2        In        CV number  
 1        Opaque object ID handle returned by  
 KamDecoderPutAdd.

15    2        Maximum CV is 1024. Maximum CV for this decoder is  
 given by KamCVGetMaxRegister.  
 Return Value    Type            Range            Description  
 iError short 1            Error flag  
 20    1        iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamProgramCV takes the decoder object ID, configuration  
 variable (CV) number as parameters. It reads the  
 specified CV variable value to the server database.

25    OKamProgramCV  
 Parameter List Type    Range            Direction    Description  
 lDecoderObjectID long        1        In        Decoder object ID  
 iCVRegint        2        In        CV number  
 30    iCVValue        int        0-255    In        CV value  
 1        Opaque object ID handle returned by  
 KamDecoderPutAdd.  
 2        Maximum CV is 1024. Maximum CV for this decoder is  
 given by KamCVGetMaxRegister.

35    Return Value    Type            Range            Description  
 iError short 1            Error flag  
 1        iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamProgramCV takes the decoder object ID, configuration  
 variable (CV) number, and a new CV value as parameters.  
 40    It programs (writes) a single decoder CV using the  
 specified value as source data.

OKamProgramReadDecoderToDataBase  
 45    Parameter List Type    Range            Direction    Description  
 lDecoderObjectID long        1        In        Decoder object ID  
 1        Opaque object ID handle returned by  
 KamDecoderPutAdd.  
 Return Value    Type            Range            Description  
 50    iError short 1            Error flag  
 1        iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamProgramReadDecoderToDataBase takes the decoder object  
 ID as a parameter. It reads all enabled CV values from  
 55    the decoder and stores them in the server database.

## OKamProgramDecoderFromDataBase

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID

1 Opaque object ID handle returned by

5 KamDecoderPutAdd.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).

10 KamProgramDecoderFromDataBase takes the decoder object ID as a parameter. It programs (writes) all enabled decoder CV values using the server copy of the CVs as source data.

15

## A. Commands to control all decoder types

20 This section describes the commands that all decoder types. These commands do things such getting the maximum address a given type of decoder supports, adding decoders to the database, etc.

## OKamDecoderGetMaxModels

Parameter	List	Type	Range	Direction	Description
piMaxModels		int * 1		Out	Pointer to Max model ID

1 Normally 1-65535. 0 on error.

Return Value	Type	Range	Description
iError	short	1	Error flag

30 1 iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).

KamDecoderGetMaxModels takes no parameters. It sets the memory pointed to by *piMaxModels* to the maximum decoder type ID.

35

## OKamDecoderGetModelName

Parameter	List	Type	Range	Direction	Description
iModel	int	1-65535	1	In	Decoder type ID
pbsModelName	BSTR *	2		Out	Decoder name string

40

1 Maximum value for this server given by  
KamDecoderGetMaxModels.

2 Exact return type depends on language. It is  
Cstring \* for C++. Empty string on error.

Return Value	Type	Range	Description
iError	short	1	Error flag

45 1 iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg). KamPortGetModelName takes a  
decoder type ID and a pointer to a string as parameters.  
50 It sets the memory pointed to by *pbsModelName* to a BSTR  
containing the decoder name.

OKamDecoderSetModelToObj

Parameter	List	Type	Range	Direction	Description
iModel	int	1	In		Decoder model ID
lDecoderObjectID		long	1	In	Decoder object ID

5 1 Maximum value for this server given by KamDecoderGetMaxModels.  
 2 Opaque object ID handle returned by KamDecoderPutAdd.

Return Value	Type	Range	Description
iError	short	1	Error flag

10 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).  
 KamDecoderSetModelToObj takes a decoder ID and decoder object ID as parameters. It sets the decoder model type  
 15 of the decoder at address lDecoderObjectID to the type specified by iModel.

OKamDecoderGetMaxAddress

Parameter	List	Type	Range	Direction	Description
iModel	int	1	In		Decoder type ID
piMaxAddress	int * 2		Out		Maximum decoder address

20 1 Maximum value for this server given by KamDecoderGetMaxModels.  
 25 2 Model dependent. 0 returned on error.

Return Value	Type	Range	Description
iError	short	1	Error flag

30 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).  
 KamDecoderGetMaxAddress takes a decoder type ID and a pointer to store the maximum address as parameters. It sets the memory pointed to by piMaxAddress to the maximum address supported by the specified decoder.

OKamDecoderChangeOldNewAddr

Parameter	List	Type	Range	Direction	Description
lOldObjID		long	1	In	Old decoder object ID
iNewAddr		int	2	In	New decoder address
plNewObjID		long * 1	Out		New decoder object ID

40 1 Opaque object ID handle returned by KamDecoderPutAdd.  
 2 1-127 for short locomotive addresses. 1-10239 for long locomotive decoders. 0-511 for accessory decoders.

Return Value	Type	Range	Description
iError	short	1	Error flag

45 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).  
 KamDecoderChangeOldNewAddr takes an old decoder object ID and a new decoder address as parameters. It moves the  
 50 specified locomotive or accessory decoder to iNewAddr and sets the memory pointed to by plNewObjID to the new object ID. The old object ID is now invalid and should no longer be used.

OKamDecoderMovePort

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
iLogicalPortID		int	1-65535	2 In	Logical port ID

5     1     Opaque object ID handle returned by  
KamDecoderPutAdd.  
2     Maximum value for this server given by  
KamPortGetMaxLogPorts.

Return Value	Type	Range	Description
iError	short	1	Error flag

10    1     iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).  
KamDecoderMovePort takes a decoder object ID and logical  
port ID as parameters. It moves the decoder specified by  
15    lDecoderObjectID to the controller specified by  
iLogicalPortID.

OKamDecoderGetPort

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
piLogicalPortID		int *	1-65535	2 Out	Pointer to logical port ID

20    1     Opaque object ID handle returned by  
KamDecoderPutAdd.  
25    2     Maximum value for this server given by  
KamPortGetMaxLogPorts.

Return Value	Type	Range	Description
iError	short	1	Error flag

30    1     iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).  
KamDecoderMovePort takes a decoder object ID and pointer  
to a logical port ID as parameters. It sets the memory  
pointed to by piLogicalPortID to the logical port ID  
associated with lDecoderObjectID.

35    OKamDecoderCheckAddrInUse

Parameter	List	Type	Range	Direction	Description
iDecoderAddress		int	1	In	Decoder address
iLogicalPortID		int	2	In	Logical Port ID
iDecoderClass		int	3	In	Class of decoder

40    1     Opaque object ID handle returned by  
KamDecoderPutAdd.  
2     Maximum value for this server given by  
KamPortGetMaxLogPorts.

45    3     1 - DECODER\_ENGINE\_TYPE,  
2     2 - DECODER\_SWITCH\_TYPE,  
3     3 - DECODER\_SENSOR\_TYPE.

Return Value	Type	Range	Description
iError	short	1	Error flag

50    1     iError = 0 for successful call and address not in  
use. Nonzero is an error number (see  
KamMiscGetErrorMsg). IDS\_ERR\_ADDRESSEXIST returned if  
call succeeded but the address exists.



KamDecoderCheckAddrInUse takes a decoder address, logical port, and decoder class as parameters. It returns zero if the address is not in use. It will return  
 5 IDS\_ERR\_ADDRESSEXIST if the call succeeds but the address already exists. It will return the appropriate non zero error number if the calls fails.

OKamDecoderGetModelFromObj

Parameter	List	Type	Range	Direction	Description
10	lDecoderObjectID	long		1 In	Decoder object ID
	piModelint *	1-65535	2	Out	Pointer to decoder type ID

1 Opaque object ID handle returned by KamDecoderPutAdd.

15 2 Maximum value for this server given by KamDecoderGetMaxModels.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number  
 20 (see KamMiscGetErrorMsg).  
 KamDecoderGetModelFromObj takes a decoder object ID and pointer to a decoder type ID as parameters. It sets the memory pointed to by piModel to the decoder type ID associated with iDCCAddr.

25 OKamDecoderGetModelFacility

Parameter	List	Type	Range	Direction	Description
	lDecoderObjectID	long		1 In	Decoder object ID
30	pdwFacility	long *	2	Out	Pointer to decoder facility mask

1 Opaque object ID handle returned by KamDecoderPutAdd.

2 0 - DCODE\_PRGMODE\_ADDR

35 1 - DCODE\_PRGMODE\_REG

2 - DCODE\_PRGMODE\_PAGE

3 - DCODE\_PRGMODE\_DIR

4 - DCODE\_PRGMODE\_FLYSHT

5 - DCODE\_PRGMODE\_FLYLNG

6 - Reserved

40 7 - Reserved

8 - Reserved

9 - Reserved

10 - Reserved

11 - Reserved

45 12 - Reserved

13 - DCODE\_FEAT\_DIRLIGHT

14 - DCODE\_FEAT\_LNGADDR

15 - DCODE\_FEAT\_CVENABLE

16 - DCODE\_FEDMODE\_ADDR

50 17 - DCODE\_FEDMODE\_REG

18 - DCODE\_FEDMODE\_PAGE

19 - DCODE\_FEDMODE\_DIR

20 - DCODE\_FEDMODE\_FLYSHT

21 - DCODE\_FEDMODE\_FLYLNG

	Return Value	Type	Range	Description
	<i>iError</i>	short	1	Error flag
	1	<i>iError</i> = 0 for success. Nonzero is an error number (see <i>KamMiscGetErrorMsg</i> ).		
5	<i>KamDecoderGetModelFacility</i> takes a decoder object ID and pointer to a decoder facility mask as parameters. It sets the memory pointed to by <i>pdwFacility</i> to the decoder facility mask associated with <i>iDCCAddr</i> .			
10	<i>OKamDecoderGetObjCount</i>			
	Parameter List	Type	Range	Direction Description
	<i>iDecoderClass</i>	int	1	In Class of decoder
	<i>piObjCount</i>	int *	0-65535	Out Count of active decoders
15	1	1 - <i>DECODER_ENGINE_TYPE</i> , 2 - <i>DECODER_SWITCH_TYPE</i> , 3 - <i>DECODER_SENSOR_TYPE</i> .		
	Return Value	Type	Range	Description*
	<i>iError</i>	short	1	Error flag
20	1	<i>iError</i> = 0 for success. Nonzero is an error number (see <i>KamMiscGetErrorMsg</i> ).		
	<i>KamDecoderGetObjCount</i> takes a decoder class and a pointer to an address count as parameters. It sets the memory pointed to by <i>piObjCount</i> to the count of active decoders			
25	of the type given by <i>iDecoderClass</i> .			
	<i>OKamDecoderGetObjAtIndex</i>			
	Parameter List	Type	Range	Direction Description*
	<i>iIndex</i>	int	1	In Decoder array index
30	<i>iDecoderClass</i>	int	2	In Class of decoder
	<i>plDecoderObjectID</i>	long *	3	Out Pointer to decoder object ID
	1	0 to ( <i>KamDecoderGetAddressCount</i> - 1).		
	2	1 - <i>DECODER_ENGINE_TYPE</i> , 2 - <i>DECODER_SWITCH_TYPE</i> , 3 - <i>DECODER_SENSOR_TYPE</i> .		
35	3	Opaque object ID handle returned by <i>KamDecoderPutAdd</i> .		
	Return Value	Type	Range	Description
40	<i>iError</i>	short	1	Error flag
	1	<i>iError</i> = 0 for success. Nonzero is an error number (see <i>KamMiscGetErrorMsg</i> ).		
	<i>KamDecoderGetObjCount</i> takes a decoder index, decoder class, and a pointer to an object ID as parameters. It			
45	sets the memory pointed to by <i>plDecoderObjectID</i> to the selected object ID.			
	<i>OKamDecoderPutAdd</i>			
	Parameter List	Type	Range	Direction Description
50	<i>iDecoderAddress</i>	int	1	In Decoder address
	<i>iLogicalCmdPortID</i>	int	1-65535	2 In Logical command port ID

```

iLogicalProgPortID  int    1-65535 2    In    Logical
                                     programming
                                     port ID

iClearState         int     3          In    Clear state flag
5 iModel             int     4          In    Decoder model type ID
plDecoderObjectID   long * 5          Out    Decoder
                                     object ID
1      1-127 for short locomotive addresses. 1-10239 for
long locomotive decoders. 0-511 for accessory decoders.
10 2      Maximum value for this server given by
KamPortGetMaxLogPorts.
3      0 - retain state, 1 - clear state.
4      Maximum value for this server given by
KamDecoderGetMaxModels.
15 5      Opaque object ID handle. The object ID is used to
reference the decoder.
Return Value  Type      Range      Description
iError       short    1          Error flag
1      iError = 0 for success. Nonzero is an error number
20 (see KamMiscGetErrorMsg).
KamDecoderPutAdd takes a decoder object ID, command
logical port, programming logical port, clear flag,
decoder model ID, and a pointer to a decoder object ID as
parameters. It creates a new locomotive object in the
25 locomotive database and sets the memory pointed to by
plDecoderObjectID to the decoder object ID used by the
server as a key.

OKamDecoderPutDel
30 Parameter List Type      Range      Direction  Description
lDecoderObjectID long      1          In    Decoder object ID
iClearState     int       2          In    Clear state flag
1      Opaque object ID handle returned by
KamDecoderPutAdd.
35 2      0 - retain state, 1 - clear state.
Return Value  Type      Range      Description*
iError       short    1          Error flag
1      iError = 0 for success. Nonzero is an error number
40 (see KamMiscGetErrorMsg).
KamDecoderPutDel takes a decoder object ID and clear flag
as parameters. It deletes the locomotive object specified
by lDecoderObjectID from the locomotive database.

OKamDecoderGetMfgName
45 Parameter List Type      Range      Direction  Description
lDecoderObjectID long      1          In    Decoder object ID
pbsMfgName     BSTRT * 2          Out    Pointer to
                                     manufacturer name
1      Opaque object ID handle returned by
50 KamDecoderPutAdd.
2      Exact return type depends on language. It is
Cstring * for C++. Empty string on error.

```

	Return Value	Type	Range	Description
	iError	short	1	Error flag
	1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		
5	KamDecoderGetMfgName takes a decoder object ID and pointer to a manufacturer name string as parameters. It sets the memory pointed to by pbsMfgName to the name of the decoder manufacturer.			
10	OKamDecoderGetPowerMode			
	Parameter List	Type	Range	Direction Description
	lDecoderObjectID		long	1 In Decoder object ID
	pbsPowerMode	BSTR *	2	Out Pointer to decoder power mode
15	1	Opaque object ID handle returned by KamDecoderPutAdd.		
	2	Exact return type depends on language. It is Cstring * for C++. Empty string on error.		
20	Return Value	Type	Range	Description
	iError	short	1	Error flag
	1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		
	KamDecoderGetPowerMode takes a decoder object ID and a pointer to the power mode string as parameters. It sets the memory pointed to by pbsPowerMode to the decoder power mode.			
25				
	OKamDecoderGetMaxSpeed			
30	Parameter List	Type	Range	Direction Description
	lDecoderObjectID		long	1 In Decoder object ID
	piSpeedStep	int *	2	Out Pointer to max speed step
	1	Opaque object ID handle returned by KamDecoderPutAdd.		
35	2	14, 28, 56, or 128 for locomotive decoders. 0 for accessory decoders.		
	Return Value	Type	Range	Description
	iError	short	1	Error flag
40	1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		
	KamDecoderGetMaxSpeed takes a decoder object ID and a pointer to the maximum supported speed step as parameters. It sets the memory pointed to by piSpeedStep to the maximum speed step supported by the decoder.			
45				

#### A. Commands to control locomotive decoders

50 This section describes the commands that control locomotive decoders. These commands control things such as locomotive speed and direction. For efficiency, a copy of all the engine variables such speed is stored in the server. Commands such as KamEngGetSpeed

communicate only with the server, not the actual decoder. You should first make any changes to the server copy of the engine variables. You can send all changes to the engine using the KamCmdCommand command.

5 OKamEngGetSpeed

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
lpSpeed		int *	2	Out	Pointer to locomotive speed
lpDirection		int *	3	Out	Pointer to locomotive direction

1 Opaque object ID handle returned by KamDecoderPutAdd.

15 2 Speed range is dependent on whether the decoder is set to 14,18, or 128 speed steps and matches the values defined by NMRA S9.2 and RP 9.2.1. 0 is stop and 1 is emergency stop for all modes.

20 3 Forward is boolean TRUE and reverse is boolean FALSE.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

25 KamEngGetSpeed takes the decoder object ID and pointers to locations to store the locomotive speed and direction as parameters. It sets the memory pointed to by lpSpeed to the locomotive speed and the memory pointed to by lpDirection to the locomotive direction.

30 OKamEngPutSpeed

Parameter	List	Type	Range	Direction	Description*
lDecoderObjectID		long	1	In	Decoder object ID
iSpeed	int	2	In		Locomotive speed
iDirection	int	3	In		Locomotive direction

1 Opaque object ID handle returned by KamDecoderPutAdd.

2 Speed range is dependent on whether the decoder is set to 14,18, or 128 speed steps and matches the values defined by NMRA S9.2 and RP 9.2.1. 0 is stop and 1 is emergency stop for all modes.

40 3 Forward is boolean TRUE and reverse is boolean FALSE.

Return Value	Type	Range	Description
iError	short	1	Error flag

45 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

50 KamEngPutSpeed takes the decoder object ID, new locomotive speed, and new locomotive direction as parameters. It sets the locomotive database speed to iSpeed and the locomotive database direction to iDirection. Note: This command only changes the locomotive database. The data is not sent to the decoder until execution of the KamCmdCommand command. Speed is

set to the maximum possible for the decoder if *iSpeed* exceeds the decoders range.

#### OKamEngGetSpeedSteps

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
lpSpeedSteps	int *	14,28,128		Out	Pointer to number of speed steps

1 Opaque object ID handle returned by KamDecoderPutAdd.

Return Value	Type	Range	Description
iError	short	1	Error flag
1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).			

15 KamEngGetSpeedSteps takes the decoder object ID and a pointer to a location to store the number of speed steps as a parameter. It sets the memory pointed to by *lpSpeedSteps* to the number of speed steps.

#### OKamEngPutSpeedSteps

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
iSpeedSteps	int	14,28,128		In	Locomotive speed steps

25 1 Opaque object ID handle returned by KamDecoderPutAdd.

Return Value	Type	Range	Description
iError	short	1	Error flag
1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).			

30 KamEngPutSpeedSteps takes the decoder object ID and a new number of speed steps as a parameter. It sets the number of speed steps in the locomotive database to *iSpeedSteps*. Note: This command only changes the locomotive database. The data is not sent to the decoder until execution of the KamCmdCommand command. KamDecoderGetMaxSpeed returns the maximum possible speed for the decoder. An error is generated if an attempt is made to set the speed steps beyond this value.

#### OKamEngGetFunction

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
iFunctionID	int	0-8	2	In	Function ID number
lpFunction	int *	3		Out	Pointer to function value

45 1 Opaque object ID handle returned by KamDecoderPutAdd.

2 FL is 0. F1-F8 are 1-8 respectively. Maximum for this decoder is given by KamEngGetFunctionMax. 3 Function active is boolean TRUE and inactive is boolean FALSE.

Return Value	Type	Range	Description
iError	short	1	Error flag
1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

5 KamEngGetFunction takes the decoder object ID, a function ID, and a pointer to the location to store the specified function state as parameters. It sets the memory pointed to by *lpFunction* to the specified function state.

10 OKamEngPutFunction

Parameter List	Type	Range	Direction	Description
lDecoderObjectID	long	1	In	Decoder object ID
iFunctionID	int	0-8	2	In Function ID number
iFunction	int	3	In	Function value

15 1 Opaque object ID handle returned by KamDecoderPutAdd.  
 2 FL is 0. FL-F8 are 1-8 respectively. Maximum for this decoder is given by KamEngGetFunctionMax.  
 3 Function active is boolean TRUE and inactive is boolean FALSE.

20 Return Value Type Range Description  
 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

25 KamEngPutFunction takes the decoder object ID, a function ID, and a new function state as parameters. It sets the specified locomotive database function state to *iFunction*. Note: This command only changes the locomotive database. The data is not sent to the decoder until execution of the KamCmdCommand command.

30 OKamEngGetFunctionMax

Parameter List	Type	Range	Direction	Description
lDecoderObjectID	long	1	In	Decoder object ID
piMaxFunction	int *	0-8	Out	Pointer to maximum function number

35 1 Opaque object ID handle returned by KamDecoderPutAdd:

Return Value	Type	Range	Description
iError	short	1	Error flag
1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

40 KamEngGetFunctionMax takes a decoder object ID and a pointer to the maximum function ID as parameters. It sets the memory pointed to by *piMaxFunction* to the maximum possible function number for the specified decoder.

45

## OKamEngGetName

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
pbsEngName	BSTR *	2	Out		Pointer to locomotive name

1 Opaque object ID handle returned by KamDecoderPutAdd.

2 Exact return type depends on language. It is Cstring \* for C++. Empty string on error.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

15 KamEngGetName takes a decoder object ID and a pointer to the locomotive name as parameters. It sets the memory pointed to by pbsEngName to the name of the locomotive.

## OKamEngPutName

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
bsEngName	BSTR	2	Out		Locomotive name

1 Opaque object ID handle returned by KamDecoderPutAdd.

25 LPCSTR for C++.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

30 KamEngPutName takes a decoder object ID and a BSTR as parameters. It sets the symbolic locomotive name to bsEngName.

## OKamEngGetFunctionName

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
iFunctionID	int	0-8	2	In	Function ID number
pbsFcnNameString	BSTR *	3	Out		Pointer to function name

40 1 Opaque object ID handle returned by KamDecoderPutAdd.

2 FL is 0. F1-F8 are 1-8 respectively. Maximum for this decoder is given by KamEngGetFunctionMax. 3 Exact return type depends on language. It is Cstring \* for C++.

Return Value	Type	Range	Description
iError	short	1	Error flag

45 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

50 KamEngGetFunctionName takes a decoder object ID, function ID, and a pointer to the function name as parameters. It sets the memory pointed to by pbsFcnNameString to the symbolic name of the specified function.

55



OKamEngPutFunctionName

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
iFunctionID		int	0-8 2	In	Function ID number
bsFcnNameString		BSTR	3	In	Function name

5     1     Opaque object ID handle returned by  
KamDecoderPutAdd.  
2     FL is 0. F1-F8 are 1-8 respectively. Maximum for  
this decoder is given by KamEngGetFunctionMax.  
10    3     Exact parameter type depends on language. It is  
LPCSTR for C++.

Return Value	Type	Range	Description
iError	short	1	Error flag

15    1     iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).  
KamEngPutFunctionName takes a decoder object ID, function  
ID, and a BSTR as parameters. It sets the specified  
symbolic function name to *bsFcnNameString*.

20    OKamEngGetConsistMax

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In	Decoder object ID
piMaxConsist		int * 2	2	Out	Pointer to max consist number

25    1     Opaque object ID handle returned by  
KamDecoderPutAdd.  
2     Command station dependent.

Return Value	Type	Range	Description
iError	short	1	Error flag

30    1     iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).  
KamEngGetConsistMax takes the decoder object ID and a  
pointer to a location to store the maximum consist as  
parameters. It sets the location pointed to by  
35    *piMaxConsist* to the maximum number of locomotives that  
can but placed in a command station controlled consist.  
Note that this command is designed for command station  
consisting. CV consisting is handled using the CV  
commands.

40    OKamEngPutConsistParent

Parameter	List	Type	Range	Direction	Description
lDCCParentObjID		long	1	In	Parent decoder object ID
iDCCAliasAddr		int	2	In	Alias decoder address

45    1     Opaque object ID handle returned by  
KamDecoderPutAdd.  
2     1-127 for short locomotive addresses. 1-10239 for  
long locomotive decoders.

Return Value	Type	Range	Description
iError	short	1	Error flag

50    1     iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).  
KamEngPutConsistParent takes the parent object ID and an  
55    alias address as parameters. It makes the decoder

specified by *lDCCParentObjID* the consist parent referred to by *lDCCAliasAddr*. Note that this command is designed for command station consisting. CV consisting is handled using the CV commands. If a new parent is defined for a consist; the old parent becomes a child in the consist. To delete a parent in a consist without deleting the consist, you must add a new parent then delete the old parent using *KamEngPutConsistRemoveObj*.

#### 10 OKamEngPutConsistChild

Parameter	List	Type	Range	Direction	Description
<i>lDCCParentObjID</i>		long	1	In	Parent decoder object ID
<i>lDCCObjID</i>		long	1	In	Decoder object ID

15 1 Opaque object ID handle returned by *KamDecoderPutAdd*.

Return Value	Type	Range	Description
<i>iError</i>	short	1	Error flag
1 <i>iError</i> = 0 for success. Nonzero is an error number (see <i>KamMiscGetErrorMsg</i> ).			

20 *KamEngPutConsistChild* takes the decoder parent object ID and decoder object ID as parameters. It assigns the decoder specified by *lDCCObjID* to the consist identified by *lDCCParentObjID*. Note that this command is designed for command station consisting. CV consisting is handled using the CV commands. Note: This command is invalid if the parent has not been set previously using *KamEngPutConsistParent*.

#### 30 OKamEngPutConsistRemoveObj

Parameter	List	Type	Range	Direction	Description
<i>lDecoderObjectID</i>		long	1	In	Decoder object ID
1					Opaque object ID handle returned by <i>KamDecoderPutAdd</i> .

35 Return Value Type Range Description  
*iError* short 1 Error flag  
 1 *iError* = 0 for success. Nonzero is an error number (see *KamMiscGetErrorMsg*).

40 *KamEngPutConsistRemoveObj* takes the decoder object ID as a parameter. It removes the decoder specified by *lDecoderObjectID* from the consist. Note that this command is designed for command station consisting. CV consisting is handled using the CV commands. Note: If the parent is removed, all children are removed also.

45

### A. Commands to control accessory decoders

50 This section describes the commands that control accessory decoders. These commands control things such as accessory decoder activation state. For efficiency, a copy of all the engine variables such speed is stored in the server. Commands such as *KamAccGetFunction* communicate only with the server, not the actual decoder. You should first make any changes to

55

the server copy of the engine variables. You can send all changes to the engine using the KamCmdCommand command.

5 OKamAccGetFunction

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long		1 In	Decoder object ID
iFunctionID		int	0-31 2	In	Function ID number
lpFunction		int *	3	Out	Pointer to function value

10 1 Opaque object ID handle returned by KamDecoderPutAdd.  
 2 Maximum for this decoder is given by KamAccGetFunctionMax.  
 15 3 Function active is boolean TRUE and inactive is boolean FALSE.

Return Value	Type	Range	Description
iError	short	1	Error flag

20 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).  
 KamAccGetFunction takes the decoder object ID, a function ID, and a pointer to the location to store the specified function state as parameters. It sets the memory pointed to by lpFunction to the specified function state.

25 OKamAccGetFunctionAll

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long		1 In	Decoder object ID
piValue		int *	2	Out	Function bit mask

30 1 Opaque object ID handle returned by KamDecoderPutAdd.  
 2 Each bit represents a single function state. Maximum for this decoder is given by KamAccGetFunctionMax.

Return Value	Type	Range	Description
iError	short	1	Error flag

35 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).  
 KamAccGetFunctionAll takes the decoder object ID and a pointer to a bit mask as parameters. It sets each bit in the memory pointed to by piValue to the corresponding function state.

40 OKamAccPutFunction

Parameter	List	Type	Range	Direction	Description
lDecoderObjectID		long		1 In	Decoder object ID
iFunctionID		int	0-31 2	In	Function ID number
iFunction		int	3	In	Function value

45 1 Opaque object ID handle returned by KamDecoderPutAdd.  
 50 2 Maximum for this decoder is given by KamAccGetFunctionMax.  
 3 Function active is boolean TRUE and inactive is boolean FALSE.

Return Value	Type	Range	Description
iError	short	1	Error flag
1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

5 KamAccPutFunction takes the decoder object ID, a function ID, and a new function state as parameters. It sets the specified accessory database function state to iFunction. Note: This command only changes the accessory database. The data is not sent to the decoder until execution of

10 the KamCmdCommand command.

OKamAccPutFunctionAll

Parameter List	Type	Range	Direction	Description
lDecoderObjectID		long	1 In	Decoder object ID
iValue	int	2 In		Pointer to function state array
1	Opaque object ID handle returned by KamDecoderPutAdd.			
2	Each bit represents a single function state.			
20	Maximum for this decoder is given by KamAccGetFunctionMax.			

Return Value	Type	Range	Description
iError	short	1	Error flag
1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

25 KamAccPutFunctionAll takes the decoder object ID and a bit mask as parameters. It sets all decoder function enable states to match the state bits in iValue. The possible enable states are TRUE and FALSE. The data is

30 not sent to the decoder until execution of the KamCmdCommand command.

OKamAccGetFunctionMax

Parameter List	Type	Range	Direction	Description
lDecoderObjectID		long	1 In	Decoder object ID
piMaxFunction	int *	0-31 2	Out	Pointer to maximum function number
1	Opaque object ID handle returned by KamDecoderPutAdd.			
40	2 Maximum for this decoder is given by KamAccGetFunctionMax.			

Return Value	Type	Range	Description
iError	short	1	Error flag
1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

45 KamAccGetFunctionMax takes a decoder object ID and pointer to the maximum function number as parameters. It sets the memory pointed to by piMaxFunction to the maximum possible function number for the specified

50 decoder.

OKamAccGetName

Parameter List	Type	Range	Direction	Description
lDecoderObjectID		long	1 In	Decoder object ID
pbsAccNameString		BSTR *	2 Out	Accessory name

55

1     Opaque object ID handle returned by  
 KamDecoderPutAdd.

2     Exact return type depends on language. It is  
 Cstring \* for C++. Empty string on error.

5     Return Value    Type            Range            Description  
 iError   short   1            Error flag

1     iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

10    KamAccGetName takes a decoder object ID and a pointer to  
 a string as parameters. It sets the memory pointed to by  
 pbsAccNameString to the name of the accessory.

OKamAccPutName

15    Parameter List Type   Range        Direction    Description  
 lDecoderObjectID   long        1        In    Decoder object ID  
 bsAccNameString    BSTR        2        In    Accessory name

1     Opaque object ID handle returned by  
 KamDecoderPutAdd.

20    2     Exact parameter type depends on language. It is  
 LPCSTR for C++.

Return Value    Type            Range            Description  
 iError   short   1            Error flag

1     iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

25    KamAccPutName takes a decoder object ID and a BSTR as  
 parameters. It sets the symbolic accessory name to  
 bsAccName.

OKamAccGetFunctionName

30    Parameter List Type   Range        Direction    Description  
 lDecoderObjectID   long        1        In    Decoder object ID  
 iFunctionID        int        0-31 2        In    Function ID number  
 pbsFcnNameString   BSTR \* 3        Out    Pointer to  
 function name

35    1     Opaque object ID handle returned by  
 KamDecoderPutAdd.

2     Maximum for this decoder is given by  
 KamAccGetFunctionMax.

40    3     Exact return type depends on language. It is  
 Cstring \* for C++. Empty string on error.

Return Value    Type            Range            Description®  
 iError   short   1            Error flag

1     iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

45    KamAccGetFuncntionName takes a decoder object ID,  
 function ID, and a pointer to a string as parameters. It  
 sets the memory pointed to by pbsFcnNameString to the  
 symbolic name of the specified function.

50    OKamAccPutFunctionName

Parameter List Type   Range        Direction    Description  
 lDecoderObjectID   long        1        In    Decoder object ID  
 iFunctionID        int        0-31 2        In    Function ID number  
 bsFcnNameString    BSTR        3        In    Function name

1 Opaque object ID handle returned by  
 KamDecoderPutAdd.  
 2 Maximum for this decoder is given by  
 KamAccGetFunctionMax.  
 5 3 Exact parameter type depends on language. It is  
 LPCSTR for C++.

Return Value	Type	Range	Description
iError	short	1	Error flag
1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

10 KamAccPutFunctionName takes a decoder object ID, function  
 ID, and a BSTR as parameters. It sets the specified  
 symbolic function name to *bsFcnNameString*.

15 OKamAccRegFeedback

Parameter List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In Decoder object ID
bsAccNode	BSTR	1	In	Server node name
iFunctionID	int	0-31	3	In Function ID number

20 1 Opaque object ID handle returned by  
 KamDecoderPutAdd.  
 2 Exact parameter type depends on language. It is  
 LPCSTR for C++.  
 3 Maximum for this decoder is given by  
 KamAccGetFunctionMax.

Return Value	Type	Range	Description
iError	short	1	Error flag
1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

30 KamAccRegFeedback takes a decoder object ID, node name  
 string, and function ID, as parameters. It registers  
 interest in the function given by *iFunctionID* by the  
 method given by the node name string *bsAccNode*.  
*bsAccNode* identifies the server application and method to  
 call if the function changes state. Its format is  
 35 "\\{Server}\\{App}.{Method}" where {Server} is the server  
 name, {App} is the application name, and {Method} is the  
 method name.

40 OKamAccRegFeedbackAll

Parameter List	Type	Range	Direction	Description
lDecoderObjectID		long	1	In Decoder object ID
bsAccNode	BSTR	2	In	Server node name

45 1 Opaque object ID handle returned by  
 KamDecoderPutAdd.  
 2 Exact parameter type depends on language. It is  
 LPCSTR for C++.

Return Value	Type	Range	Description
iError	short	1	Error flag
1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

50 KamAccRegFeedbackAll takes a decoder object ID and node  
 name string as parameters. It registers interest in all  
 functions by the method given by the node name string

*bsAccNode*. *bsAccNode* identifies the server application and method to call if the function changes state. Its format is "\\{Server}\\{App}.{Method}" where {Server} is the server name, {App} is the application name, and {Method} is the method name.

OKamAccDelFeedback

Parameter List	Type	Range	Direction	Description
lDecoderObjectID	long		1 In	Decoder object ID
bsAccNode	BSTR		2 In	Server node name
iFunctionID	int	0-31	3 In	Function ID number

1 Opaque object ID handle returned by KamDecoderPutAdd.

2 Exact parameter type depends on language. It is LPCSTR for C++.

3 Maximum for this decoder is given by KamAccGetFunctionMax.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

KamAccDelFeedback takes a decoder object ID, node name string, and function ID, as parameters. It deletes interest in the function given by *iFunctionID* by the method given by the node name string *bsAccNode*.

*bsAccNode* identifies the server application and method to call if the function changes state. Its format is "\\{Server}\\{App}.{Method}" where {Server} is the server name, {App} is the application name, and {Method} is the method name.

OKamAccDelFeedbackAll

Parameter List	Type	Range	Direction	Description
lDecoderObjectID	long		1 In	Decoder object ID
bsAccNode	BSTR	2	In	Server node name

1 Opaque object ID handle returned by KamDecoderPutAdd.

2 Exact parameter type depends on language. It is LPCSTR for C++.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

KamAccDelFeedbackAll takes a decoder object ID and node name string as parameters. It deletes interest in all functions by the method given by the node name string *bsAccNode*. *bsAccNode* identifies the server application and method to call if the function changes state. Its format is "\\{Server}\\{App}.{Method}" where {Server} is the server name, {App} is the application name, and {Method} is the method name.

# A. Commands to control the command station

5 This section describes the commands that control the command station. These commands do things such as controlling command station power. The steps to control a given command station vary depending on the type of command station.

10 OKamOprPutTurnOnStation  
 Parameter List Type Range Direction Description  
 iLogicalPortID int 1-65535 1 In Logical port ID  
 1 Maximum value for this server given by  
 KamPortGetMaxLogPorts.  
 Return Value Type Range Description  
 15 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamOprPutTurnOnStation takes a logical port ID as a  
 20 parameter. It performs the steps necessary to turn on  
 the command station. This command performs a combination  
 of other commands such as KamOprPutStartStation,  
 KamOprPutClearStation, and KamOprPutPowerOn.

25 OKamOprPutStartStation  
 Parameter List Type Range Direction Description  
 iLogicalPortID int 1-65535 1 In Logical port ID  
 1 Maximum value for this server given by  
 KamPortGetMaxLogPorts.  
 Return Value Type Range Description  
 30 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamOprPutStartStation takes a logical port ID as a  
 parameter. It performs the steps necessary to start the  
 35 command station.

OKamOprPutClearStation  
 Parameter List Type Range Direction Description  
 40 iLogicalPortID int 1-65535 1 In Logical port ID  
 1 Maximum value for this server given by  
 KamPortGetMaxLogPorts.  
 Return Value Type Range Description  
 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 45 (see KamMiscGetErrorMsg).  
 KamOprPutClearStation takes a logical port ID as a  
 parameter. It performs the steps necessary to clear the  
 command station queue.

50 OKamOprPutStopStation  
 Parameter List Type Range Direction Description  
 iLogicalPortID int 1-65535 1 In Logical port ID  
 1 Maximum value for this server given by  
 KamPortGetMaxLogPorts.



Return Value    Type            Range            Description  
 iError   short   1            Error flag  
 1        iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

5    KamOprPutStopStation takes a logical port ID as a  
 parameter. It performs the steps necessary to stop the  
 command station.

OKamOprPutPowerOn

10   Parameter List Type    Range            Direction    Description  
 iLogicalPortID int    1-65535    1        In        Logical port ID  
 1        Maximum value for this server given by  
 KamPortGetMaxLogPorts.

Return Value    Type            Range            Description  
 15   iError   short   1            Error flag  
 1        iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

KamOprPutPowerOn takes a logical port ID as a parameter.  
 It performs the steps necessary to apply power to the  
 20   track.

OKamOprPutPowerOff

25   Parameter List Type    Range            Direction    Description  
 iLogicalPortID int    1-65535    1        In        Logical port ID  
 1        Maximum value for this server given by  
 KamPortGetMaxLogPorts.

Return Value    Type            Range            Description  
 iError   short   1            Error flag  
 1        iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

30   KamOprPutPowerOff takes a logical port ID as a parameter.  
 It performs the steps necessary to remove power from the  
 track.

OKamOprPutHardReset

35   Parameter List Type    Range            Direction    Description  
 iLogicalPortID int    1-65535    1        In        Logical port ID  
 1        Maximum value for this server given by  
 KamPortGetMaxLogPorts.

40   Return Value    Type            Range            Description  
 iError   short   1            Error flag  
 1        iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

KamOprPutHardReset takes a logical port ID as a  
 45   parameter. It performs the steps necessary to perform a  
 hard reset of the command station.

OKamOprPutEmergencyStop

50   Parameter List Type    Range            Direction    Description  
 iLogicalPortID int    1-65535    1        In        Logical port ID  
 1        Maximum value for this server given by  
 KamPortGetMaxLogPorts.

Return Value    Type            Range            Description  
 iError   short   1            Error flag

1     *iError* = 0 for success. Nonzero is an error number  
(see *KamMiscGetErrorMsg*).

5     *KamOprPutEmergencyStop* takes a logical port ID as a  
parameter. It performs the steps necessary to broadcast  
an emergency stop command to all decoders.

0*KamOprGetStationStatus*

Parameter	List	Type	Range	Direction	Description
<i>iLogicalPortID</i>	int		1-65535	1 In	Logical port ID
<i>pbsCmdStat</i>	BSTR	* 2		Out	Command station status string

1     Maximum value for this server given by  
*KamPortGetMaxLogPorts*.

2     Exact return type depends on language. It is  
15    Cstring \* for C++.

Return Value	Type	Range	Description
<i>iError</i>	short	1	Error flag

1     *iError* = 0 for success. Nonzero is an error number  
(see *KamMiscGetErrorMsg*).

20    *KamOprGetStationStatus* takes a logical port ID and a  
pointer to a string as parameters. It set the memory  
pointed to by *pbsCmdStat* to the command station status.  
The exact format of the status BSTR is vendor dependent.

25    A.    Commands to configure the command station  
communication port

30    This section describes the commands that  
configure the command station communication port. These  
commands do things such as setting BAUD rate. Several of  
the commands in this section use the numeric controller  
ID (*iControllerID*) to identify a specific type of  
command station controller. The following table shows  
35    the mapping between the controller ID (*iControllerID*) and  
controller name (*bsControllerName*) for a given type of  
command station controller.

<i>iControllerID</i>	<i>bsControllerName</i>	Description
40    0	UNKNOWN	Unknown controller type
1	SIMULAT	Interface simulator
2	LENZ_1x	Lenz version 1 serial support module
3	LENZ_2x	Lenz version 2 serial support module
45    4	DIGIT_DT200	Digitrax direct drive support using DT200
5	DIGIT_DCS100	Digitrax direct drive support using DCS100
6	MASTERSERIES	North coast engineering master series
50    7	SYSTEMONE	System one
8	RAMFIX	RAMFixx system
9	SERIAL	NMRA serial interface
10    10	EASYDCC	CVP Easy DCC
11    11	MRK6050	Marklin 6050 interface (AC and DC)
55    12	MRK6023	Marklin 6023 interface (AC)

13	DIGIT_PR1	Digitrax direct drive using PR1
14	DIRECT	Direct drive interface routine
15	ZTC	ZTC system ltd
16	TRIX	TRIX controller

5

	iIndex	Name	iValue	Values
	0	RETRANS	10-255	
	1	RATE	0 - 300 BAUD, 1 - 1200 BAUD, 2 - 2400 BAUD, 3 - 4800 BAUD, 4 - 9600 BAUD, 5 - 14400 BAUD, 6 - 16400 BAUD, 7 - 19200 BAUD	
10	2	PARITY0	NONE, 1 - ODD, 2 - EVEN, 3 - MARK, 4 - SPACE	
	3	STOP	0 - 1 bit, 1 - 1.5 bits, 2 - 2 bits	
	4	WATCHDOG	500 - 65535 milliseconds. Recommended value 2048	
15	5	FLOW	0 - NONE, 1 - XON/XOFF, 2 - RTS/CTS, 3 BOTH	
	6	DATA	0 - 7 bits, 1 - 8 bits	
	7	DEBUG	Bit mask. Bit 1 sends messages to debug file. Bit 2 sends messages to the screen. Bit 3 shows queue data. Bit 4 shows UI status. Bit 5 is reserved. Bit 6 shows semaphore and critical sections. Bit 7 shows miscellaneous messages. Bit 8 shows comm port activity. 130 decimal is recommended for debugging.	
20				
25	8	PARALLEL		

## OKamPortPutConfig

	Parameter	List	Type	Range	Direction	Description
	iLogicalPortID	int	2	1-65535	1 In	Logical port ID
30	iIndex	int	2	In		Configuration type index
	iValue	int	2	In		Configuration value
	iKey	int	3	In		Debug key
	1	Maximum value for this server given by KamPortGetMaxLogPorts.				
35	2	See Figure 7: Controller configuration Index values for a table of indexes and values.				
	3	Used only for the DEBUG iIndex value. Should be set to 0.				

	Return Value	Type	Range	Description
40	iError	short	1	Error flag
	1	iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).		

KamPortPutConfig takes a logical port ID, configuration index, configuration value, and key as parameters. It sets the port parameter specified by iIndex to the value specified by iValue. For the DEBUG iIndex value, the debug file path is C:\Temp\Debug{PORT}.txt where {PORT} is the physical comm port ID.

50

## OKamPortGetConfig

	Parameter	List	Type	Range	Direction	Description
	iLogicalPortID	int	2	1-65535	1 In	Logical port ID
	iIndex	int	2	In		Configuration type index
	piValue	int *	2	Out		Pointer to configuration value

1 Maximum value for this server given by  
KamPortGetMaxLogPorts.

2 See Figure 7: Controller configuration Index values  
for a table of indexes and values.

Return Value Type Range Description  
iError short 1 Error flag  
1 iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).

KamPortGetConfig takes a logical port ID, configuration  
index, and a pointer to a configuration value as  
parameters. It sets the memory pointed to by piValue to  
the specified configuration value.

OKamPortGetName

Parameter	List	Type	Range	Direction	Description
iPhysicalPortID	int	1-65535	1	In	Physical port number

pbsPortName BSTR \* 2 Out Physical port name

1 Maximum value for this server given by  
KamPortGetMaxPhysical.

2 Exact return type depends on language. It is  
CString \* for C++. Empty string on error.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).

KamPortGetName takes a physical port ID number and a  
pointer to a port name string as parameters. It sets the  
memory pointed to by pbsPortName to the physical port  
name such as "COMM1."

OKamPortPutMapController

Parameter	List	Type	Range	Direction	Description
iLogicalPortID	int	1-65535	1	In	Logical port ID
iControllerID	int	1-65535	2	In	Command station type ID
iCommPortID	int	1-65535	3	In	Physical comm port ID

1 Maximum value for this server given by  
KamPortGetMaxLogPorts.

2 See Figure 6: Controller ID to controller name  
mapping for values. Maximum value for this server is  
given by KamMiscMaxControllerID.

3 Maximum value for this server given by  
KamPortGetMaxPhysical.

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number  
(see KamMiscGetErrorMsg).

KamPortPutMapController takes a logical port ID, a  
command station type ID, and a physical communications  
port ID as parameters. It maps iLogicalPortID to

*iCommPortID* for the type of command station specified by *iControllerID*.

5 OKamPortGetMaxLogPorts  
 Parameter List Type Range Direction Description  
 piMaxLogicalPorts int \* 1 Out Maximum logical  
 port ID  
 1 Normally 1 - 65535. 0 returned on error.  
 Return Value Type Range Description  
 10 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamPortGetMaxLogPorts takes a pointer to a logical port  
 ID as a parameter. It sets the memory pointed to by  
 15 piMaxLogicalPorts to the maximum logical port ID.

OKamPortGetMaxPhysical  
 Parameter List Type Range Direction Description  
 20 pMaxPhysical int \* 1 Out Maximum physical  
 port ID  
 pMaxSerial int \* 1 Out Maximum serial  
 port ID  
 pMaxParallel int \* 1 Out Maximum parallel  
 port ID  
 25 1 Normally 1 - 65535. 0 returned on error.  
 Return Value Type Range Description  
 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 30 KamPortGetMaxPhysical takes a pointer to the number of  
 physical ports, the number of serial ports, and the  
 number of parallel ports as parameters. It sets the  
 memory pointed to by the parameters to the associated  
 values  
 35

A. Commands that control command flow to the command  
 station

40 This section describes the commands that  
 control the command flow to the command station. These  
 commands do things such as connecting and disconnecting  
 from the command station.

45 OKamCmdConnect  
 Parameter List Type Range Direction Description  
 iLogicalPortID int 1-65535 1 In Logical port ID  
 1 Maximum value for this server given by  
 KamPortGetMaxLogPorts.  
 50 Return Value Type Range Description  
 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

KamCmdConnect takes a logical port ID as a parameter. It connects the server to the specified command station.

#### OKamCmdDisconnect

5 Parameter List Type Range Direction Description  
 iLogicalPortID int 1-65535 1 In Logical port ID  
 1 Maximum value for this server given by  
 KamPortGetMaxLogPorts.

Return Value Type Range Description  
 10 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

15 KamCmdDisconnect takes a logical port ID as a parameter.  
 It disconnects the server to the specified command  
 station.

#### OKamCmdCommand

20 Parameter List Type Range Direction Description  
 lDecoderObjectID long 1 In Decoder object ID  
 1 Opaque object ID handle returned by  
 KamDecoderPutAdd.

Return Value Type Range Description  
 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 25 (see KamMiscGetErrorMsg).

KamCmdCommand takes the decoder object ID as a parameter.  
 It sends all state changes from the server database to  
 the specified locomotive or accessory decoder.

30

### A. Cab Control Commands

35 This section describes commands that control  
 the cabs attached to a command station.

#### OKamCabGetMessage

Parameter List Type Range Direction Description  
 iCabAddress int 1-65535 1 In Cab address  
 40 pbsMsg BSTR \* 2 Out Cab message string  
 1 Maximum value is command station dependent.

2 Exact return type depends on language. It is  
 Cstring \* for C++. Empty string on error.

Return Value Type Range Description  
 iError short 1 Error flag  
 45 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).

KamCabGetMessage takes a cab address and a pointer to a  
 message string as parameters. It sets the memory pointed  
 to by pbsMsg to the present cab message.



## A. Miscellaneous Commands

This section describes miscellaneous commands that do not fit into the other categories.

5 OKamMiscGetErrorMsg  
 Parameter List Type Range Direction Description  
 iError int 0-65535 1 In Error flag  
 1 iError = 0 for success. Nonzero indicates an error.

10 Return Value Type Range Description  
 bsErrorString BSTR 1 Error string  
 1 Exact return type depends on language. It is Cstring for C++. Empty string on error.  
 KamMiscGetErrorMsg takes an error flag as a parameter.  
 15 It returns a BSTR containing the descriptive error message associated with the specified error flag.

OKamMiscGetClockTime  
 Parameter List Type Range Direction Description  
 20 iLogicalPortID int 1-65535 1 In Logical port ID  
 iSelectTimeMode int 2 In Clock source  
 piDay int \* 0-6 Out Day of week  
 piHours int \* 0-23 Out Hours  
 piMinutes int \* 0-59 Out Minutes  
 25 piRatio int \* 3 Out Fast clock ratio  
 1 Maximum value for this server given by KamPortGetMaxLogPorts.  
 2 0 - Load from command station and sync server.  
 1 - Load direct from server. 2 - Load from cached server  
 30 copy of command station time.  
 3 Real time clock ratio.

Return Value Type Range Description  
 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 35 (see KamMiscGetErrorMsg).  
 KamMiscGetClockTime takes the port ID, the time mode, and pointers to locations to store the day, hours, minutes, and fast clock ratio as parameters. It sets the memory pointed to by piDay to the fast clock day, sets pointed  
 40 to by piHours to the fast clock hours, sets the memory pointed to by piMinutes to the fast clock minutes, and the memory pointed to by piRatio to the fast clock ratio.  
 The servers local time will be returned if the command station does not support a fast clock.

45 OKamMiscPutClockTime  
 Parameter List Type Range Direction Description  
 iLogicalPortID int 1-65535 1 In Logical port ID  
 iDay int 0-6 In Day of week  
 50 iHours int 0-23 In Hours  
 iMinutes int 0-59 In Minutes  
 iRatio int 2 In Fast clock ratio  
 1 Maximum value for this server given by KamPortGetMaxLogPorts.  
 2 Real time clock ratio.

55 Return Value Type Range Description



iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamMiscPutClockTime takes the fast clock logical port,  
 5 the fast clock day, the fast clock hours, the fast clock  
 minutes, and the fast clock ratio as parameters. It sets  
 the fast clock using specified parameters.

OKamMiscGetInterfaceVersion  
 10 Parameter List Type Range Direction Description  
 pbsInterfaceVersion BSTR \* 1 Out Pointer to interface  
 version string  
 1 Exact return type depends on language. It is  
 Cstring \* for C++. Empty string on error.

15 Return Value Type Range Description  
 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamMiscGetInterfaceVersion takes a pointer to an  
 20 interface version string as a parameter. It sets the  
 memory pointed to by pbsInterfaceVersion to the interface  
 version string. The version string may contain multiple  
 lines depending on the number of interfaces supported.

25 OKamMiscSaveData  
 Parameter List Type Range Direction Description  
 NONE

Return Value Type Range Description  
 30 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 (see KamMiscGetErrorMsg).  
 KamMiscSaveData takes no parameters. It saves all server  
 data to permanent storage. This command is run  
 35 automatically whenever the server stops running. Demo  
 versions of the program cannot save data and this command  
 will return an error in that case.

OKamMiscGetControllerName  
 40 Parameter List Type Range Direction Description  
 iControllerID int 1-65535 1 In Command station  
 type ID  
 pbsName BSTR \* 2 Out Command station type  
 name

45 1 See Figure 6: Controller ID to controller name  
 mapping for values. Maximum value for this server is  
 given by KamMiscMaxControllerID.  
 2 Exact return type depends on language. It is  
 Cstring \* for C++. Empty string on error.

50 Return Value Type Range Description  
 bsName BSTR 1 Command station type name  
 Return Value Type Range Description  
 iError short 1 Error flag  
 1 iError = 0 for success. Nonzero is an error number  
 55 (see KamMiscGetErrorMsg).

KamMiscGetControllerName takes a command station type ID and a pointer to a type name string as parameters. It sets the memory pointed to by *pbsName* to the command station type name.

5

OKamMiscGetControllerNameAtPort

Parameter	List	Type	Range	Direction	Description
iLogicalPortID	int		1-65535	1 In	Logical port ID
pbsName	BSTR *		2	Out	Command station type name

10

1 Maximum value for this server given by KamPortGetMaxLogPorts.

2 Exact return type depends on language. It is Cstring \* for C++. Empty string on error.

15

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

KamMiscGetControllerName takes a logical port ID and a pointer to a command station type name as parameters. It sets the memory pointed to by *pbsName* to the command station type name for that logical port.

20

OKamMiscGetCommandStationValue

Parameter	List	Type	Range	Direction	Description
iControllerID	int		1-65535	1 In	Command station type ID
iLogicalPortID	int		1-65535	2 In	Logical port ID
iIndex	int		3 In		Command station array index
piValue	int *		0 - 65535	Out	Command station value

30

1 See Figure 6: Controller ID to controller name mapping for values. Maximum value for this server is given by KamMiscMaxControllerID.

2 Maximum value for this server given by

KamPortGetMaxLogPorts.

3 0 to KamMiscGetCommandStationIndex .

Return Value	Type	Range	Description
iError	short	1	Error flag

1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

40

KamMiscGetCommandStationValue takes the controller ID, logical port, value array index, and a pointer to the location to store the selected value. It sets the memory pointed to by *piValue* to the specified command station miscellaneous data value.

45

OKamMiscSetCommandStationValue

Parameter	List	Type	Range	Direction	Description
iControllerID	int	1-65535	1	In	Command station type ID
iLogicalPortID	int	1-65535	2	In	Logical port ID
iIndex	int	3	In		Command station array index
iValue	int	0 - 65535	In		Command station value

1 See Figure 6: Controller ID to controller name mapping for values. Maximum value for this server is given by KamMiscMaxControllerID.

10 2 Maximum value for this server given by KamPortGetMaxLogPorts. 3 0 to KamMiscGetCommandStationIndex.

15 Return Value Type Range Description

Parameter	List	Type	Range	Description
iError	short	1	Error flag	

1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

20 KamMiscSetCommandStationValue takes the controller ID, logical port, value array index, and new miscellaneous data value. It sets the specified command station data to the value given by piValue.

25 OKamMiscGetCommandStationIndex

Parameter	List	Type	Range	Direction	Description
iControllerID	int	1-65535	1	In	Command station type ID
iLogicalPortID	int	1-65535	2	In	Logical port ID
piIndex	int	0-65535	Out		Pointer to maximum index

30 1 See Figure 6: Controller ID to controller name mapping for values. Maximum value for this server is given by KamMiscMaxControllerID.

35 2 Maximum value for this server given by KamPortGetMaxLogPorts.

Return Value Type Range Description

Parameter	List	Type	Range	Description
iError	short	1	Error flag	

40 1 iError = 0 for success. Nonzero is an error number (see KamMiscGetErrorMsg).

45 KamMiscGetCommandStationIndex takes the controller ID, logical port, and a pointer to the location to store the maximum index. It sets the memory pointed to by piIndex to the specified command station maximum miscellaneous data index.

OKamMiscMaxControllerID

Parameter	List	Type	Range	Direction	Description
piMaxControllerID	int *	1-65535	1	Out	Maximum controller type ID

50 1 See Figure 6: Controller ID to controller name mapping for a list of controller ID values. 0 returned on error.

Return Value Type Range Description

Parameter	List	Type	Range	Description
iError	short	1	Error flag	

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The digital command stations 18 program the digital devices, such as a locomotive and switches, of the railroad layout. For example, a locomotive may include several different registers that control the

horn, how the light blinks, speed curves for operation, etc. In many such locomotives there are 106 or more programable values. Unfortunately, it may take 1-10 seconds per byte wide word if a valid register or control variable (generally referred to collectively as registers) and two to four minutes to error out if an invalid register to program such a locomotive or device, either of which may contain a decoder. With a large number of byte wide words in a locomotive its takes considerable time to fully program the locomotive. Further, with a railroad layout including many such locomotives and other programmable devices, it takes a substantial amount of time to completely program all the devices of the model railroad layout. During the programming of the railroad layout, the operator is sitting there not enjoying the operation of the railroad layout, is frustrated, loses operating enjoyment, and will not desire to use digital programmable devices. In addition, to reprogram the railroad layout the operator must reprogram all of the devices of the entire railroad layout which takes substantial time. Similarly, to determine the state of all the devices of the railroad layout the operator must read the registers of each device likewise taking substantial time. Moreover, to reprogram merely a few bytes of a particular device requires the operator to previously know the state of the registers of the device which is obtainable by reading the registers of the device taking substantial time, thereby still frustrating the operator.

The present inventor came to the realization that for the operation of a model railroad the anticipated state of the individual devices of the railroad, as programmed, should be maintained during the use of the model railroad and between different uses of the model railroad. By maintaining data representative of the current state of the device registers of the model railroad determinations may be made to efficiently

program the devices. When the user designates a command to be executed by one or more of the digital command stations 18, the software may determine which commands need to be sent to one or more of the digital command stations 18 of the model railroad. By only updating those registers of particular devices that are necessary to implement the commands of a particular user, the time necessary to program the railroad layout is substantially reduced. For example, if the command would duplicate the current state of the device then no command needs to be forwarded to the digital command stations 18. This prevents redundantly programming the devices of the model railroad, thereby freeing up the operation of the model railroad for other activities.

Unlike a single-user single-railroad environment, the system of the present invention may encounter "conflicting" commands that attempt to write to and read from the devices of the model railroad. For example, the "conflicting" commands may inadvertently program the same device in an inappropriate manner, such as the locomotive to speed up to maximum and the locomotive to stop. In addition, a user that desires to read the status of the entire model railroad layout will monopolize the digital decoders and command stations for a substantial time, such as up to two hours, thereby preventing the enjoyment of the model railroad for the other users. Also, a user that programs an extensive number of devices will likewise monopolize the digital decoders and command stations for a substantial time thereby preventing the enjoyment of the model railroad for other users.

In order to implement a networked selective updating technique the present inventor determined that it is desirable to implement both a write cache and a read cache. The write cache contains those commands yet to be programmed by the digital command stations 18. Valid commands from each user are passed to a queue in

the write cache. In the event of multiple commands from multiple users (depending on user permissions and security) or the same user for the same event or action, the write cache will concatenate the two commands into a single command to be programmed by the digital command stations 18. In the event of multiple commands from multiple users or the same user for different events or actions, the write cache will concatenate the two commands into a single command to be programmed by the digital command stations 18. The write cache may forward either of the commands, such as the last received command, to the digital command station. The users are updated with the actual command programmed by the digital command station, as necessary.

The read cache contains the state of the different devices of the model railroad. After a command has been written to a digital device and properly acknowledged, if necessary, the read cache is updated with the current state of the model railroad. In addition, the read cache is updated with the state of the model railroad when the registers of the devices of the model railroad are read. Prior to sending the commands to be executed by the digital command stations 18 the data in the write cache is compared against the data in the read cache. In the event that the data in the read cache indicates that the data in the write cache does not need to be programmed, the command is discarded. In contrast, if the data in the read cache indicates that the data in the write cache needs to be programmed, then the command is programmed by the digital command station. After programming the command by the digital command station the read cache is updated to reflect the change in the model railroad. As becomes apparent, the use of a write cache and a read cache permits a decrease in the number of registers that need to be programmed, thus speeding up the apparent operation of the model railroad to the operator.

The present inventor further determined that errors in the processing of the commands by the railroad and the initial unknown state of the model railroad should be taken into account for a robust system. In the event that an error is received in response to an attempt to program (or read) a device, then the state of the relevant data of the read cache is marked as unknown. The unknown state merely indicates that the state of the register has some ambiguity associated therewith. The unknown state may be removed by reading the current state of the relevant device or the data rewritten to the model railroad without an error occurring. In addition, if an error is received in response to an attempt to program (or read) a device, then the command may be re-transmitted to the digital command station in an attempt to program the device properly. If desirable, multiple commands may be automatically provided to the digital command stations to increase the likelihood of programming the appropriate registers. In addition, the initial state of a register is likewise marked with an unknown state until data becomes available regarding its state.

When sending the commands to be executed by the digital command stations 18 they are preferably first checked against the read cache, as previously mentioned. In the event that the read cache indicates that the state is unknown, such as upon initialization or an error, then the command should be sent to the digital command station because the state is not known. In this manner the state will at least become known, even if the data in the registers is not actually changed.

The present inventor further determined a particular set of data that is useful for a complete representation of the state of the registers of the devices of the model railroad.

An invalid representation of a register indicates that the particular register is not



valid for both a read and a write operation. This permits the system to avoid attempting to read from and write to particular registers of the model railroad. This avoids the  
5 exceptionally long error out when attempting to access invalid registers.

An in use representation of a register indicates that the particular register is valid  
10 for both a read and a write operation. This permits the system to read from and write to particular registers of the model railroad. This assists in accessing valid registers where the response time is relatively fast.

15 A read error (unknown state) representation of a register indicates that each time an attempt to read a particular register results in an error.

20 A read dirty representation of a register indicates that the data in the read cache has not been validated by reading its valid from the decoder. If both the read error and the  
25 read dirty representations are clear then a valid read from the read cache may be performed. A read dirty representation may be cleared by a successful write operation, if desired.

30 A read only representation indicates that the register may not be written to. If this flag is set then a write error may not occur.

35 A write error (unknown state) representation of a register indicates that each time an attempt

to write to a particular register results in an error.

5 A write dirty representation of a register indicates that the data in the write cache has not been written to the decoder yet. For example, when programming the decoders the system programs the data indicated by the write dirty. If both the write error and the write  
10 dirty representations are clear then the state is represented by the write cache. This assists in keeping track of the programming without excess overhead.

15 A write only representation indicates that the register may not be read from. If this flag is set then a read error may not occur.

20 Over time the system constructs a set of representations of the model railroad devices and the model railroad itself indicating the invalid registers, read errors, and write errors which may increase the efficiency of programming and changing the states of the model railroad. This permits the system to avoid  
25 accessing particular registers where the result will likely be an error.

The present inventor came to the realization that the valid registers of particular devices is the same for the same device of the same or different model  
30 railroads. Further, the present inventor came to the realization that a template may be developed for each particular device that may be applied to the representations of the data to predetermine the valid registers. In addition, the template may also be used to  
35 set the read error and write error, if desired. The template may include any one or more of the following representations, such as invalid, in use, read error,

write only, read dirty, read only, write error, and write  
dirty for the possible registers of the device. The  
predetermination of the state of each register of a  
particular device avoids the time consuming activity of  
5 receiving a significant number of errors and thus  
constructing the caches. It is to be noted that the  
actual read and write cache may be any suitable type of  
data structure.

Many model railroad systems include computer  
10 interfaces to attempt to mimic or otherwise emulate the  
operation of actual full-scale railroads. FIG. 4  
illustrates the organization of train dispatching by  
"timetable and train order" (T&TO) techniques. Many of  
the rules governing T&TO operation are related to the  
15 superiority of trains which principally is which train  
will take siding at the meeting point. Any  
misinterpretation of these rules can be the source of  
either hazard or delay. For example, misinterpreting the  
rules may result in one train colliding with another  
20 train.

For trains following each other, T&TO operation  
must rely upon time spacing and flag protection to keep  
each train a sufficient distance apart. For example, a  
train may not leave a station less than five minutes  
25 after the preceding train has departed. Unfortunately,  
there is no assurance that such spacing will be retained  
as the trains move along the line, so the flagman (rear  
brakeman) of a train slowing down or stopping will light  
and throw off a five-minute red flare which may not be  
30 passed by the next train while lit. If a train has to  
stop, a flagman trots back along the line with a red flag  
or lantern a sufficient distance to protect the train,  
and remains there until the train is ready to move at  
which time he is called back to the train. A flare and  
35 two track torpedoes provide protection as the flagman  
scrambles back and the train resumes speed. While this

type of system works, it depends upon a series of human activities.

It is perfectly possible to operate a railroad safely without signals. The purpose of signal systems is not so much to increase safety as it is to step up the efficiency and capacity of the line in handling traffic. Nevertheless, it's convenient to discuss signal system principals in terms of three types of collisions that signals are designed to prevent, namely, rear-end, side-on, and head-on.

Block signal systems prevent a train from ramming the train ahead of it by dividing the main line into segments, otherwise known as blocks, and allowing only one train in a block at a time, with block signals indicating whether or not the block ahead is occupied. In many blocks, the signals are set by a human operator. Before clearing the signal, he must verify that any train which has previously entered the block is now clear of it, a written record is kept of the status of each block, and a prescribed procedure is used in communicating with the next operator. The degree to which a block frees up operation depends on whether distant signals (as shown in FIG. 5) are provided and on the spacing of open stations, those in which an operator is on duty. If as is usually the case it is many miles to the next block station and thus trains must be equally spaced. Nevertheless, manual block does afford a high degree of safety.

The block signaling which does the most for increasing line capacity is automatic block signals (ABS), in which the signals are controlled by the trains themselves. The presence or absence of a train is determined by a track circuit. Invented by Dr. William Robinson in 1872, the track circuit's key feature is that it is fail-safe. As can be seen in FIG. 6, if the battery or any wire connection fails, or a rail is broken, the relay can't pick up, and a clear signal will not be displayed.

The track circuit is also an example of what is designated in railway signaling practice as a vital circuit, one which can give an unsafe indication if some of its components malfunction in certain ways. The track circuit is fail-safe, but it could still give a false clear indication should its relay stick in the closed or picked-up position. Vital circuit relays, therefore, are built to very stringent standards: they are large devices; rely on gravity (no springs) to drop their armature; and use special non-loading contacts which will not stick together if hit by a large surge of current (such as nearby lightning).

Getting a track circuit to be absolutely reliable is not a simple matter. The electrical leakage between the rails is considerable, and varies greatly with the seasons of the year and the weather. The joints and bolted-rail track are by-passed with bond wire to assure low resistance at all times, but the total resistance still varies. It is lower, for example, when cold weather shrinks the rails and they pull tightly on the track bolts or when hot weather expands to force the ends tightly together. Battery voltage is typically limited to one or two volts, requiring a fairly sensitive relay. Despite this, the direct current track circuit can be adjusted to do an excellent job and false-clears are extremely rare. The principal improvement in the basic circuit has been to use slowly-pulsed DC so that the relay drops out and must be picked up again continually when a block is unoccupied. This allows the use of a more sensitive relay which will detect a train, but additionally work in track circuits twice as long before leakage between the rails begins to threaten reliable relay operation. Referring to FIGS. 7A and 7B, the situations determining the minimum block length for the standard two-block, three-indication ABS system. Since the train may stop with its rear car just inside the rear boundary of a block, a following train will

first receive warning just one block-length away. No allowance may be made for how far the signal indication may be seen by the engineer. Swivel block must be as long as the longest stopping distance for any train on the route, traveling at its maximum authorized speed.

From this standpoint, it is important to allow trains to move along without receiving any approach indications which will force them to slow down. This requires a train spacing of two block lengths, twice the stopping distance, since the signal can't clear until the train ahead is completely out of the second block. When fully loaded trains running at high speeds, with their stopping distances, block lengths must be long, and it is not possible to get enough trains over the line to produce appropriate revenue.

The three-block, four-indication signaling shown in FIG. 7 reduces the excess train spacing by 50% with warning two blocks to the rear and signal spacing need be only 1/2 the braking distance. In particularly congested areas such as downgrades where stopping distances are long and trains are likely to bunch up, four-block, four-indication signaling may be provided and advanced approach, approach medium, approach and stop indications give a minimum of three-block warning, allowing further block-shortening and keeps things moving.

FIG. 8 uses aspects of upper quadrant semaphores to illustrate block signaling. These signals use the blade rising 90 degrees to give the clear indication.

Some of the systems that are currently developed by different railroads are shown in FIG. 8. With the general rules discussed below, a railroad is free to establish the simplest and most easily maintained system of aspects and indications that will keep traffic moving safely and meet any special requirements due to geography, traffic pattern, or equipment. Aspects such

as flashing yellow for approach medium, for example, may be used to provide an extra indication without an extra signal head. This is safe because a stuck flasher will result in either a steady yellow approach or a more restrictive light-out aspect. In addition, there are provisions for interlocking so the trains may branch from one track to another.

To take care of junctions where trains are diverted from one route to another, the signals must control train speed. The train traveling straight through must be able to travel at full speed. Diverging routes will require some limit, depending on the turnout members and the track curvature, and the signals must control train speed to match. One approach is to have signals indicate which route has been set up and cleared for the train. In the American approach of speed signaling, in which the signal indicates not where the train is going but rather what speed is allowed through the interlocking. If this is less than normal speed, distant signals must also give warning so the train can be brought down to the speed in time. FIGS. 9A and 9B show typical signal aspects and indications as they would appear to an engineer. Once a route is established and the signal cleared, route locking is used to insure that nothing can be changed to reduce the route's speed capability from the time the train approaching it is admitted to enter until it has cleared the last switch. Additional refinements to the basic system to speed up handling trains in rapid sequence include sectional route locking which unlocks portions of the route as soon as the train has cleared so that other routes can be set up promptly. Interlocking signals also function as block signals to provide rear-end protection. In addition, at isolated crossings at grade, an automatic interlocking can respond to the approach of a train by clearing the route if there are no opposing movements cleared or in progress. Automatic interlocking returns everything to

stop after the train has passed. As can be observed, the movement of multiple trains among the track potentially involves a series of interconnected activities and decisions which must be performed by a controller, such as a dispatcher. In essence, for a railroad the dispatcher controls the operation of the trains and permissions may be set by computer control, thereby controlling the railroad. Unfortunately, if the dispatcher fails to obey the rules as put in place, traffic collisions may occur.

In the context of a model railroad the controller is operating a model railroad layout including an extensive amount of track, several locomotives (trains), and additional functionality such as switches. The movement of different objects, such as locomotives and entire trains, may be monitored by a set of sensors. The operator issues control commands from his computer console, such as in the form of permissions and class warrants for the time and track used. In the existing monolithic computer systems for model railroads a single operator from a single terminal may control the system effectively. Unfortunately, the present inventor has observed that in a multi-user environment where several clients are attempting to simultaneously control the same model railroad layout using their terminals, collisions periodically nevertheless occur. In addition, significant delay is observed between the issuance of a command and its eventual execution. The present inventor has determined that unlike full scale railroads where the track is controlled by a single dispatcher, the use of multiple dispatchers each having a different dispatcher console may result in conflicting information being sent to the railroad layout. In essence, the system is designed as a computer control system to implement commands but in no manner can the dispatcher consoles control the actions of users. For example, a user input may command that an event occur resulting in a crash. In



addition, a user may override the block permissions or class warrants for the time and track used thereby causing a collision. In addition, two users may inadvertently send conflicting commands to the same or different trains thereby causing a collision. In such a system, each user is not aware of the intent and actions of other users aside from any feedback that may be displayed on their terminal. Unfortunately, the feedback to their dispatcher console may be delayed as the execution of commands issued by one or more users may take several seconds to several minutes to be executed.

One potential solution to the dilemma of managing several users' attempt to simultaneously control a single model railroad layout is to develop a software program that is operating on the server which observes what is occurring. In the event that the software program determines that a collision is imminent, a stop command is issued to the train overriding all other commands to avoid such a collision. However, once the collision is avoided the user may, if desired, override such a command thereby restarting the train and causing a collision. Accordingly, a software program that merely oversees the operation of track apart from the validation of commands to avoid imminent collisions is not a suitable solution for operating a model railroad in a multi-user distributed environment. The present inventor determined that prior validation is important because of the delay in executing commands on the model railroad and the potential for conflicting commands. In addition, a hardware throttle directly connected to the model railroad layout may override all such computer based commands thereby resulting in the collision. Also, this implementation provides a suitable security model to use for validation of user actions.

Referring to FIG. 10, the client program 14 preferably includes a control panel 300 which provides a graphical interface (such as a personal computer with

software thereon or a dedicated hardware source) for computerized control of the model railroad 302. The graphical interface may take the form of those illustrated in FIGS. 5-9, or any other suitable command interface to provide control commands to the model railroad 302. Commands are issued by the client program 14 to the controlling interface using the control panel 300. The commands are received from the different client programs 14 by the controlling interface 16. The commands control the operation of the model railroad 302, such as switches, direction, and locomotive throttle. Of particular importance is the throttle which is a state which persists for an indefinite period of time, potentially resulting in collisions if not accurately monitored. The controlling interface 16 accepts all of the commands and provides an acknowledgment to free up the communications transport for subsequent commands. The acknowledgment may take the form of a response indicating that the command was executed thereby updating the control panel 300. The response may be subject to updating if more data becomes available indicating the previous response is incorrect. In fact, the command may have yet to be executed or verified by the controlling interface 16. After a command is received by the controlling interface 16, the controlling interface 16 passes the command (in a modified manner, if desired) to a dispatcher controller 310. The dispatcher controller 310 includes a rule-based processor together with the layout of the railroad 302 and the status of objects thereon. The objects may include properties such as speed, location, direction, length of the train, etc. The dispatcher controller 310 processes each received command to determine if the execution of such a command would violate any of the rules together with the layout and status of objects thereon. If the command received is within the rules, then the command may be passed to the model railroad 302 for execution. If the received

command violates the rules, then the command may be rejected and an appropriate response is provided to update the clients display. If desired, the invalid command may be modified in a suitable manner and still be  
5 provided to the model railroad 302. In addition, if the dispatcher controller 310 determines that an event should occur, such as stopping a model locomotive, it may issue the command and update the control panels 300 accordingly. If necessary, an update command is provided  
10 to the client program 14 to show the update that occurred.

The "asynchronous" receipt of commands together with a "synchronous" manner of validation and execution of commands from the multiple control panels 300 permits  
15 a simplified dispatcher controller 310 to be used together with a minimization of computer resources, such as com ports. In essence, commands are managed independently from the client program 14. Likewise, a centralized dispatcher controller 310 working in an "off-  
20 line" mode increases the likelihood that a series of commands that are executed will not be conflicting resulting in an error. This permits multiple model railroad enthusiasts to control the same model railroad in a safe and efficient manner. Such concerns regarding  
25 the interrelationships between multiple dispatchers does not occur in a dedicated non-distributed environment. When the command is received or validated all of the control panels 300 of the client programs 14 may likewise be updated to reflect the change. Alternatively, the  
30 controlling interface 16 may accept the command, validate it quickly by the dispatcher controller, and provide an acknowledgment to the client program 14. In this manner, the client program 14 will not require updating if the command is not valid. In a likewise manner, when a  
35 command is valid the control panel 300 of all client programs 14 should be updated to show the status of the model railroad 302.

A manual throttle 320 may likewise provide control over devices, such as the locomotive, on the model railroad 302. The commands issued by the manual throttle 320 may be passed first to the dispatcher controller 310 for validation in a similar manner to that of the client programs 14. Alternatively, commands from the manual throttle 320 may be directly passed to the model railroad 302 without first being validated by the dispatcher controller 302. After execution of commands by the external devices 18, a response will be provided to the controlling interface 16 which in response may check the suitability of the command, if desired. If the command violates the layout rules then a suitable correctional command is issued to the model railroad 302. If the command is valid then no correctional command is necessary. In either case, the status of the model railroad 302 is passed to the client programs 14 (control panels 300).

As it can be observed, the event driven dispatcher controller 310 maintains the current status of the model railroad 302 so that accurate validation may be performed to minimize conflicting and potentially damaging commands. Depending on the particular implementation, the control panel 300 is updated in a suitable manner, but in most cases, the communication transport 12 is freed up prior to execution of the command by the model railroad 302.

The computer dispatcher may also be distributed across the network, if desired. In addition, the computer architecture described herein supports different computer interfaces at the client program 14.

The present inventor has observed that periodically the commands in the queue to the digital command stations or the buffer of the digital command station overflow resulting in a system crash or loss of data. In some cases, the queue fills up with commands and then no additional commands may be accepted. After

further consideration of the slow real-time manner of operation of digital command stations, the apparent solution is to incorporate a buffer model in the interface 16 to provide commands to the digital command station at a rate no faster than the ability of the digital command station to execute the commands together with an exceptionally large computer buffer. For example, the command may take 5 ms to be transmitted from the interface 16 to the command station, 100 ms for processing by the command station, 3 ms to transfer to the digital device, such as a model train. The digital device may take 10 ms to execute the command, for example, and another 20 ms to transmit back to the digital command station which may again take 100 ms to process, and 5 ms to send the processed result to interface 16. In total, the delay may be on the order of 243 ms which is extremely long in comparison to the ability of the interface 16 to receive commands and transmit commands to the digital command station. After consideration of the timing issues and the potential solution of simply slowing down the transmission of commands to the digital command station and incorporating a large buffer, the present inventor came to the realization that a queue management system should be incorporated within the interface 16 to facilitate apparent increased responsiveness of the digital command station to the user. The particular implementation of a command queue is based on a further realization that many of the commands to operate a model railroad are "lossy" in nature which is highly unusual for a computer based queue system. In other words, if some of the commands in the command queue are never actually executed, are deleted from the command queue, or otherwise simply changed, the operation of the model railroad still functions properly. Normally a queuing system inherently requires that all commands are executed in some manner at some point in time, even if somewhat delayed.

Initially the present inventor came to the realization that when multiple users are attempting to control the same model railroad, each of them may provide the same command to the model railroad. In this event, the digital command station would receive both commands from the interface 16, process both commands, transmit both commands to the model railroad, receive both responses therefrom (typically), and provide two acknowledgments to the interface 16. In a system where the execution of commands occurs nearly instantaneously the re-execution of commands does not pose a significant problem and may be beneficial for ensuring that each user has the appropriate commands executed in the order requested. However, in the real-time environment of a model railroad all of this activity requires substantial time to complete thereby slowing down the responsiveness of the system. Commands tend to build up waiting for execution which decreases the user perceived responsiveness of control of the model railroad. The user perceiving no response continues to request commands be placed in the queue thereby exacerbating the perceived responsiveness problem. The responsiveness problem is more apparent as processor speeds of the client computer increase. Since there is but a single model railroad, the apparent speed with which commands are executed is important for user satisfaction.

Initially, the present inventor determined that duplicate commands residing in the command queue of the interface 16 should be removed. Accordingly, if different users issue the same command to the model railroad then the duplicate commands are not executed (execute one copy of the command). In addition, this alleviates the effects of a single user requesting that the same command is executed multiple times. The removal of duplicate commands will increase the apparent responsiveness of the model railroad because the time required to re-execute a command already executed will be

avoided. In this manner, other commands that will change the state of the model railroad may be executed in a more timely manner thereby increasing user satisfaction. Also, the necessary size of the command queue on the computer is reduced.

After further consideration of the particular environment of a model railroad the present inventor also determined that many command sequences in the command queue result in no net state change to the model railroad, and thus should likewise be removed from the command queue. For example, a command in the command queue to increase the speed of the locomotive, followed by a command in the command queue to reduce the speed of the locomotive to the initial speed results in no net state change to the model railroad. Any perceived increase and decrease of the locomotive would merely be the result of the time differential. It is to be understood that the comparison may be between any two or more commands. Another example may include a command to open a switch followed by a command to close a switch, which likewise results in no net state change to the model railroad. Accordingly, it is desirable to eliminate commands from the command queue resulting in a net total state change of zero. This results in a reduction in the depth of the queue by removing elements from the queue thereby potentially avoiding overflow conditions increasing user satisfaction and decreasing the probability that the user will resend the command. This results in better overall system response.

In addition to simply removing redundant commands from the command queue, the present inventor further determined that particular sequences of commands in the command queue result in a net state change to the model railroad which may be provided to the digital command station as a single command. For example, if a command in the command queue increases the speed of the locomotive by 5 units, another command in the command

queue decreases the speed of the locomotive by 3 units, the two commands may be replaced by a single command that increases the speed of the locomotive by 2 units. In this manner a reduction in the number of commands in the command queue is accomplished while at the same time effectuating the net result of the commands. This results in a reduction in the depth of the queue by removing elements from the queue thereby potentially avoiding overflow conditions. In addition, this decreases the time required to actually program the device to the net state thereby increasing user satisfaction.

With the potential of a large number of commands in the command queue taking several minutes or more to execute, the present inventor further determined that a priority based queue system should be implemented. Referring to FIG. 11, the command queue structure may include a stack of commands to be executed. Each of the commands may include a type indicator and control information as to what general type of command they are. For example, an A command may be speed commands, a B command may be switches, a C command may be lights, a D command may be query status, etc. As such, the commands may be sorted based on their type indicator for assisting the determination as to whether or not any redundancies may be eliminated or otherwise reduced.

Normally a first-in-first-out command queue provides a fair technique for the allocation of resources, such as execution of commands by the digital command station, but the present inventor determined that for slow-real-time model railroad devices such a command structure is not the most desirable. In addition, the present inventor realized that model railroads execute commands that are (1) not time sensitive, (2) only somewhat time sensitive, and (3) truly time sensitive. Non-time sensitive commands are merely query commands that inquire as to the status of certain devices.



Somewhat time sensitive commands are generally related to the appearance of devices and do not directly impact other devices; such as turning on a light. Truly time sensitive commands need to be executed in a timely fashion, such as the speed of the locomotive or moving switches. These truly time sensitive commands directly impact the perceived performance of the model railroad and therefore should be done in an out-of-order fashion. In particular, commands with a type indicative of a level of time sensitiveness may be placed into the queue in a location ahead of those that have less time sensitiveness. In this manner, the time sensitive commands may be executed by the digital command station prior to those that are less time sensitive. This provides the appearance to the user that the model railroad is operating more efficiently and responsively.

Another technique that may be used to prioritize the commands in the command queue is to assign a priority to each command. As an example, a priority of 0 would be indicative of "don't care" with a priority of 255 "do immediately," with the intermediate numbers in between being of numerical-related importance. The command queue would then place new commands in the command queue in the order of priority or otherwise provide the next command to the command station that has the highest priority within the command queue. In addition, if a particular number such as 255 is used only for emergency commands that must be executed next, then the computer may assign that value to the command so that it is next to be executed by the digital command station. Such emergency commands may include, for example, emergency stop and power off. In the event that the command queue still fills, then the system may remove commands from the command queue based on its order of priority, thereby alleviating an overflow condition in a manner less destructive to the model railroad.

In addition for multiple commands of the same type a different priority number may be assigned to each, so therefore when removing or deciding which to execute next, the priority number of each may be used to further  
5 classify commands within a given type. This provides a convenient technique of prioritizing commands.

An additional technique suitable for model railroads in combination with relatively slow real time devices is that when the system knows that there is an  
10 outstanding valid request made to the digital command station, then there is no point in making another request to the digital command station nor adding another such command to the command queue. This further removes a particular category of commands from the command queue.

15 It is to be understood that this queue system may be used in any system, such as, for example, one local machine without a network, COM, DCOM, COBRA, internet protocol, sockets, etc.

The terms and expressions which have been  
20 employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding equivalents of the features shown and described or portions thereof, it being  
25 recognized that the scope of the invention is defined and limited only by the claims which follow.